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Master Project Facilities Plan, Expansion of Reno-Sparks Joint Water Pollution Control Plant Cities of Reno and Sparks, Nevada Appendices H-K

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Appendix H - Limnology of Pyramid Lake and Lahontan Reservoir
Appendix I - Endangered and Threatened Species
Appendix J - Fish and Wildlife Resources
Appendix K - Background Agreements and Permits

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Wildlife
Nevada

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Cui-ui
Lahontan Cutthroat Trout
Endangered Species
Truckee River

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Draft Environmental Impact Statement

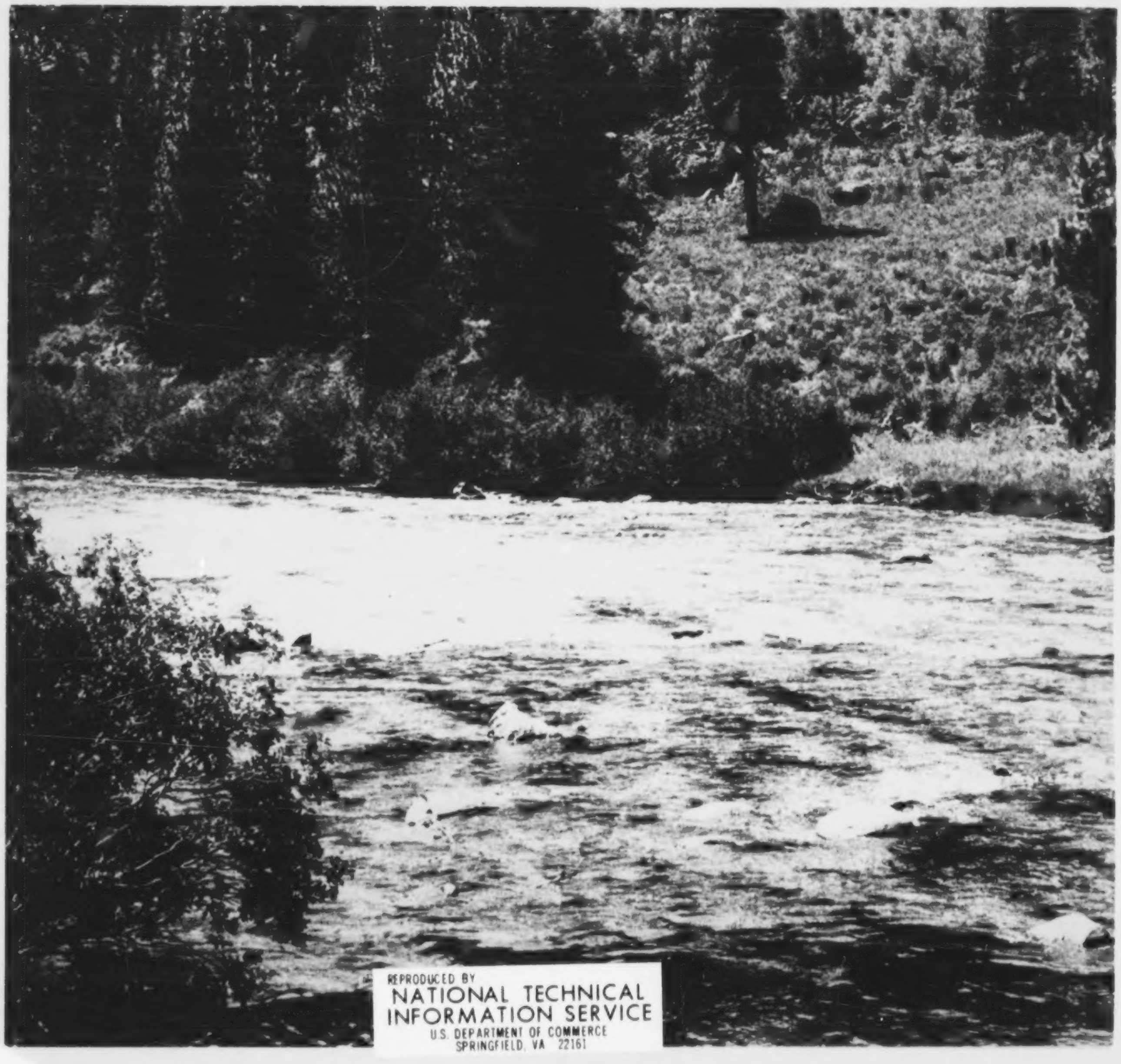
APPENDICES H-K

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

MASTER PROJECT FACILITIES PLAN

Expansion of Reno-Sparks Joint Water Pollution Control Plant

Cities of Reno and Sparks, Nevada



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APPENDICES H-K

This volume contains Appendices H-K to the Draft Environmental Impact Statement (DEIS) on the Master Project Facilities Plan, Expansion of Reno-Sparks Joint Water Pollution Control Plant. There are 11 appendices to the EIS, covering the topics listed below. The appendices are bound in three volumes, containing Appendices A-D, E-G, and H-J, respectively. The DEIS as well as the other two appendix volumes, are available from:

Mr. Thomas Severino, Project Officer
U. S. Environmental Protection Agency
Region IX
215 Fremont Street
San Francisco, CA 94105

Appendix A - Regional Economy, Future Population Growth and Housing

This appendix discusses the following topics: the Reno economy; Reno's economic future; future population growth, including population projection and forecasting techniques, and forecasts of employment growth in the State of Nevada; and housing Reno's future growth.

Appendix B - Air Quality

This appendix includes the following information: meteorology data of the Truckee Meadows area; air quality monitoring data of the Truckee Meadows; and emissions forecast for the Truckee Meadows.

Appendix C - Water Law and Water Rights

This appendix discusses the following topics: institutional constraints affecting Truckee River water rights, including discussion and case briefs of major judicial and agency actions and institutional constraints affecting the Master Project, including the Endangered Species Act, state and federal water law principles, California-Nevada interstate water compact, court decrees, administrative actions and current litigation.

Appendix D - Cultural Resources Survey for the Master Project

This appendix discusses the historic and prehistoric background of the study area, discusses the results of a 10 percent cultural resources survey of lands potentially disturbed by Master Project alternatives and identifies potential mitigation measures for adverse impacts.

Appendix E - Surface Water Hydrology

This appendix discusses the following topics relating to surface water hydrology: climate; Truckee River flow characteristics; historical flows; diversion; consumptive uses; and M&I use.

Appendix F - Surface Water Quality

This appendix discusses the following topics relating to surface water quality: water quality standards; historical water quality; various water quality studies conducted by private and governmental agencies; existing water quality; and major pollutional inputs to the Truckee River.

Appendix G - Hydrologic Modeling

This appendix discusses the hydrologic modeling that was undertaken to identify Truckee River flow and quality changes that could result from Master Project alternatives. The appendix presents the assumptions and conclusions of the modeling; the land use assumptions developed to predict declines in agricultural land use resulting from projected urban growth; urban water use assumptions; and material supplementing the results published in the EIS.

Appendix H - Limnology of Pyramid Lake and Lahontan Reservoir

Topics discussed in this appendix include physical, chemical and biological characteristics and major ecological concerns regarding Pyramid Lake and Lahontan Reservoir.

Appendix I - Endangered and Threatened Species

This appendix discusses the life history, habitat requirements, reasons for decline, physical and biological factors necessary to restore natural populations and present efforts to restore the endangered cui-ui and threatened Lahontan cutthroat trout.

Appendix J - Fish and Wildlife Resources

This appendix discusses the life histories of fishes found in the Truckee River from Verdi to Pyramid Lake and identifies wildlife species found in the study area.

Appendix K - Background Agreements and Permits

Background agreements, permits and administrative actions pertinent to the Reno-Sparks JWPCP Master Project are included in this appendix.

RENO-SPARKS JOINT WATER POLLUTION CONTROL PLANT MASTER PROJECT

DRAFT ENVIRONMENTAL IMPACT STATEMENT

Appendix H

Limnology of Pyramid Lake and Lahontan Reservoir

June 1980

Prepared For:

U. S. Environmental Protection Agency
Region IX

By:

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H-0

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ACRONYMS

DO - Dissolved oxygen
DOI - U. S. Department of the Interior
EPA - U. S. Environmental Protection Agency
NDW - Nevada Department of Wildlife
TDS - Total dissolved solids
USFWS - U. S. Fish and Wildlife Service
USGS - U. S. Geological Survey

#-Of

LIMNOLOGY OF PYRAMID LAKE AND LAHONTAN RESERVOIR

Pyramid Lake

Introduction

Pyramid Lake is a large, deep, saline-alkaline water body covering approximately 44,637 hectares (ha) (110,298 acres) (Harris, 1970, in Vigg, 1978b) in the Nevada Desert between the Lake and Virginia Mountain Ranges. It is located some 50 kilometers (km) (31 miles) northeast of Reno on the Paiute Indian reservation. The surrounding terrain is extremely rugged along the northwest shore and gently sloping along the southwest. Terrestrial vegetation in the area consists predominantly of sagebrush (*Artemisia tridentata*), salt brush (*Atriplex confertifolia*), rabbit brush (*Chrysothamnus nauseosus*), greasewood (*Sarcobatus vermiculatus*), and cheat grass (*Bromus tectorum*). Russian thistle (*Salola kali*) is abundant on exposed lakebed. Fremont cottonwood (*Populus fremonti*) and Utah juniper (*Juniperus utahensis*) are common trees in the area.

Pyramid Lake is the largest body of water in Nevada. It contains about 2.638 x 10^{10} cubic meters (m^3) (93 x 10^{10} cubic feet) of water within a basin approximately 40 k, (25 miles) long, from 6.5-16 km (4-10 miles) wide and 103 meters (m) (338 feet) deep at its maximum (Harris, 1970; Vigg, 1978b). The Truckee River terminates in closed-basin Pyramid Lake and is thus the lake's primary source of water. Small additional amounts of water enter the lake from snowmelt and from springs in the lake basin. The only outflow from the lake is evaporation. The total area tributary to the Truckee River and consequently draining into Pyramid Lake, including the Lake Tahoe basin, is about 5,076 square kilometers (km^2) (1,960 square miles) (Figure H-1) (Glancy, et al., 1972). In addition to being the major source of water to the lake, the Truckee River provides other ecological benefits. Among these are the importance of the river as a spawning area for the threatened Lahontan cutthroat trout (*Salmo clarki*), the endangered cui-ui (*Chasmistes cujus*), the Tahoe sucker (*Catostomus tahoensis*), and other organisms which spend a portion of their life cycle in the lake.

The climate of the Pyramid Lake basin is dry most of the year. Windy days are frequent, with winds occasionally reaching 65 km (40 miles) per hour. Daily temperatures range from -10°C-12°C in January and 10°C-35°C in July;

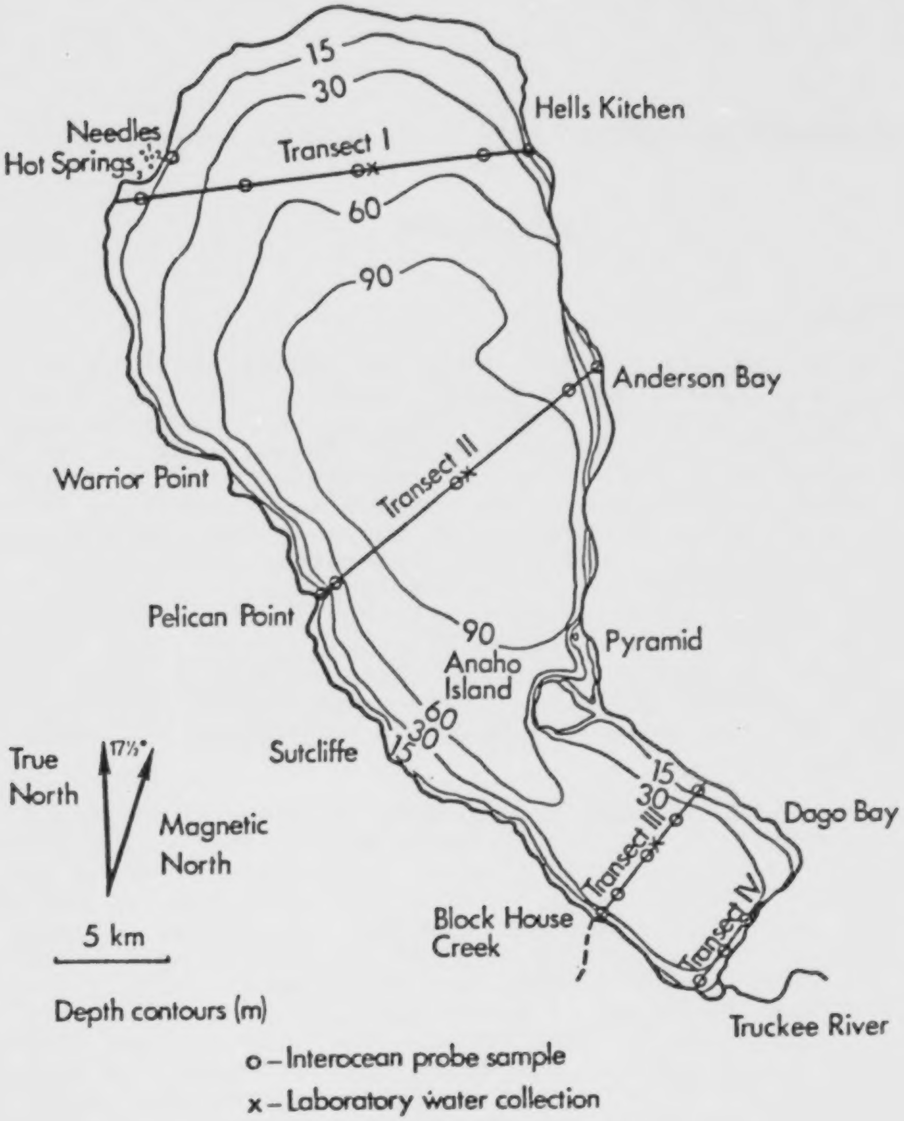

15
30
Hells Kitchen
Needles
Hot Springs
Transect I
60
90
Anderson Bay
Warrior Point
Transect II
Pelican Point
90
Pyramid
Anaho
Island
60
30
15
Sutcliffe
True
North
17½°
Magnetic
North
15
30
Dago Bay
Transect III
Transect IV
Block House
Creek
5 km
Truckee River
Depth contours (m)
o – Interocean probe sample
x – Laboratory water collection

Figure H-1. Pyramid Lake, Nevada Sampling Stations for Physical and Chemical Water Analysis, November 1975 through October 1977.

extremes on record for the basin (measured at Nixon) are -30°C and 38°C (Kennedy, et al., 1977). Average annual precipitation is 15 centimeters (cm) (6 inches), with 25-30 cm (10-12 inches) of this representing snowfall. The arid climate gives rise to an annual pan evaporation of 122 cm (48 inches) (Kennedy, et al., 1977).

Pyramid Lake is a remnant of the ancient Pleistocene Lake Lahontan. During the last glacial epoch, Lake Lahontan covered an area of 5,006,490 ha (12,371,036 acres) from west-central Nevada, north to the Oregon border (Russell, 1885, in Vigg, 1978b). The surface elevation of Lake Lahontan was as much as 183 m (600 feet) higher than the present surface elevation of Pyramid Lake. The surface elevation fluctuated widely throughout the centuries in response to climatic changes, and geologic evidence indicates that during the past several centuries the lake slowly receded due to long-term changes in climate. About 800 years ago the only portions of the basin containing water were Pyramid Lake and Winnemucca Lake. Until Winnemucca Lake dried up in 1938, these two lakes alone shared the entire natural flow of the Truckee River for several centuries (Pyramid Lake Task Force, 1971).

Limnology

Major physical, chemical, and biological characteristics of Pyramid Lake are discussed below.

Temperature. Water temperatures in the lake have been recorded to range from 0.6°C-25.5°C (Koch, 1973; in Vigg, 1978b). Lake temperatures ranged from about 6°C at the bottom in the fall and winter to above 23°C at the surface in midsummer in 1976 and 1977. Isothermal (constant temperature with depth) conditions occur in early winter and wind-generated turbulence causes the lake to turn over (mix completely) in February-March (Figures H-2 and H-3). Temperature stratification takes place by June, following wind subsidence and an increase in surface water temperature, and a pronounced metalimnion (middle layer of decreasing temperature with depth) is formed at about 22 m (72 feet), and persists until December (Kennedy, et al., 1977; Galat, et al., 1979).

Dissolved Oxygen. Dissolved oxygen (DO) profiles are shown in Figures H-2 and H-3. DO has been found to range from less than 0.1 milligrams per liter (mg/l) near the bottom in the deepest portion of the lake during fall to over 11 mg/l at the surface during June. DO was never lower than 5 mg/l in bottom waters during 1974 (Koch, et al., 1976). In 1976 the lowest DO concentration in surface waters,

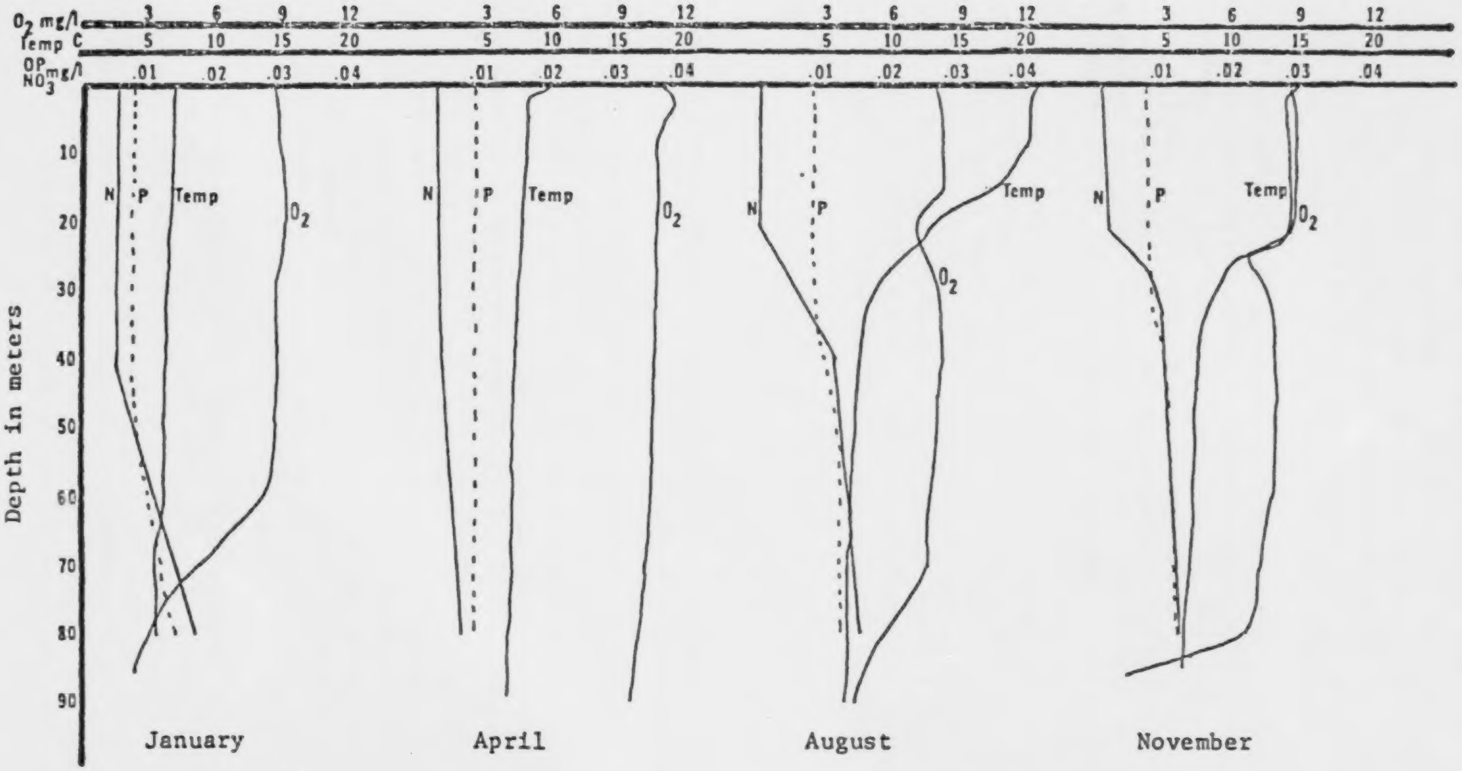


Figure H-2. Vertical changes in temperature (temp), dissolved oxygen (O_2), orthophosphates as P (P) and nitrate as N (N) in Pyramid Lake, Nevada.

SOURCE: Kennedy, et al., 1977.

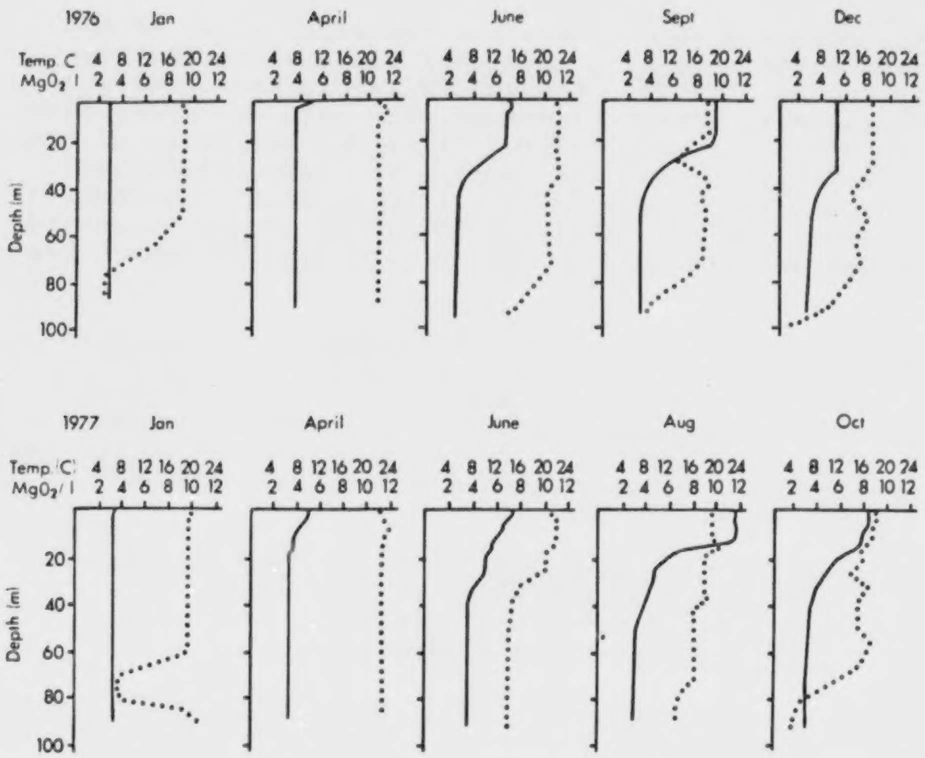


Figure H-3. Temperature (°C, Solid Line) and Dissolved Oxygen (mg/l, Broken Line) at the Deepest Station for Selected Months from January 1976 through October 1977, Pyramid Lake, Nevada.

SOURCE: Galat, pers. comm.

8.1 mg/l, occurred in October, but the usual bloom of the blue-green algae Nodularia spumigena was smaller that year (Kennedy, et al., 1977). Reduced DO levels are usually coincidental with either blooms or with mats of decomposing Nodularia (Koch, et al., 1976). "With the exception of the very deepest part of the lake during the fall, dissolved oxygen concentrations are not limiting to fish" (Kennedy, et al., 1977). Galat, et al. (1979) found oxygen concentrations minima of less than 2 mg/l in late fall in deep water (75-95 m).

Water Clarity. Secchi-disc visibility, a measure of water clarity, showed an average of 3 m and a range of between 1.2 m and 5.5 m (4-18 feet) in 1976 (Kennedy, et al., 1977). Transparency was lowest in August (Kennedy, et al., 1977) corresponding with the summer bloom of Nodularia. The euphotic depth averaged 11 m for both 1976 and 1977 (Figure H-4), Galat, et al. (1979).

Hydrogen Ion Concentration. The hydrogen ion concentration (pH) ranged from 8.85-9.06 in 1974 (Koch, et al., 1976) and from 9.0-9.4 in 1976 (Table H-1). There is apparently little variation by season or depth.

Specific Conductance and Total Dissolved Solids. Conductivity averaged 8,438 micromhos and ranged from 8,000 to 8,800 micromhos in 1976 (Table H-1). Total dissolved solids (TDS) ranged from 4,985-5,385 mg/l and averaged 5,235 mg/l in 1976. Sodium chloride is the major TDS constituent (Kennedy, et al., 1977).

Nitrogen. In 1976 concentrations of epilimnetic (surface or open water) nitrate-nitrogen (NO_3-N) averaged 0.03 mg/l and ranged from less than 0.01 mg/l to 0.06 mg/l (Kennedy, et al., 1977). Similar concentrations were reported for 1977 by Galat, et al. (1979). Nitrate levels were stratified in summer (Figure H-2). However, there was a short-term increase to 0.06 mg/l in 1977 following lake overturn which was quickly depleted to 0.01 mg/l (Galat, et al., 1979). Organic nitrogen occurred in the highest concentrations in surface waters, especially during August; lowest concentrations occurred during November. Inorganic ammonia-nitrogen (NH_4-N) ranged from less than 0.01-0.07 mg/l with maximum concentrations occurring in bottom waters when DO concentrations were below 1 mg/l. Nitrite-nitrogen (NO_2-N) concentrations were highest during the early winter of 1976 at all depths with relatively small amounts present during late summer. Nitrogen is most likely the primary limiting nutrient for nonnitrogen-fixing algae (Galat, et al., 1979).

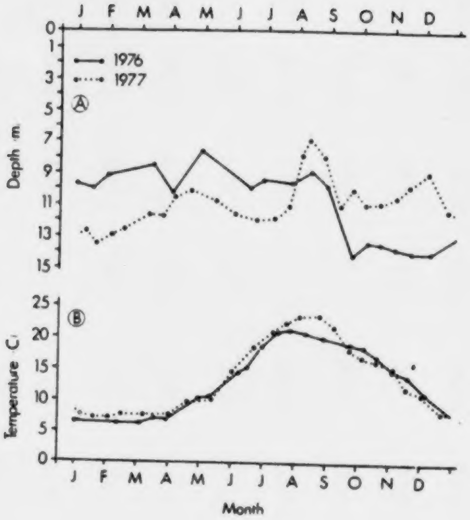


Figure H-4. Mean Pyramid Lake Euphotic Depths (A) and Surface to 10 m Mean Lake Water Temperatures (B).

SOURCE: Galat, pers. comm.

Table H-1

CHEMICAL ANALYSIS SUMMARIZED BY SEASON, SHOWING MEAN VALUES AT THREE DEPTHS AT THE DEEPEST STATION FOR PYRAMID LAKE, NEVADA FROM JANUARY THROUGH DECEMBER 1976

Season	Winter			Spring			Summer			Fall		
Depth (Meters)	1	40	80	1	40	80	1	40	80	1	40	80
pH	9.21	9.22	9.19	9.18	9.19	9.17	9.18	9.14	9.15	9.28	9.22	9.21
Specific conductance @ 25°C	8433	8517	8423	8442	8408	8442	8450	8383	8433	8450	8417	8417
Bicarbonate	798	823	846	807	774	794	860	882	878	778	787	803
Carbonate	308	302	293	309	308	317	280	263	268	321	313	294
Chloride	1951	1951	1951	2032	2034	2034	2045	2027	2009	2038	2027	2016
Sulfate	230	276	274	276	279	278	264	260	258	277	272	273
Sodium	1600	1600	1612	1611	1600	1607	1614	1600	1599	1610	1567	1592
Potassium	102	103	103	108	109	110	109	109	109	112	111	110
Calcium	9.3	9.2	9.1	9.0	8.8	8.8	9.4	9.0	9.1	9.1	8.8	8.8
Magnesium	114	115	114	113	114	114	115	114	112	114	112	113
Silica	0.95	1.0	1.53	0.88	1.04	1.24	1.10	1.20	1.70	0.96	1.40	2.02
TDS (summation)	5171	5181	5205	5265	5242	5264	5303	5270	5251	5260	5199	5212
Alkalinity (HCO_3)	1434	1439	1439	1435	1428	1437	1442	1428	1437	1431	1423	1401

SOURCE: Kennedy, et al., 1977. (See previous figure.)

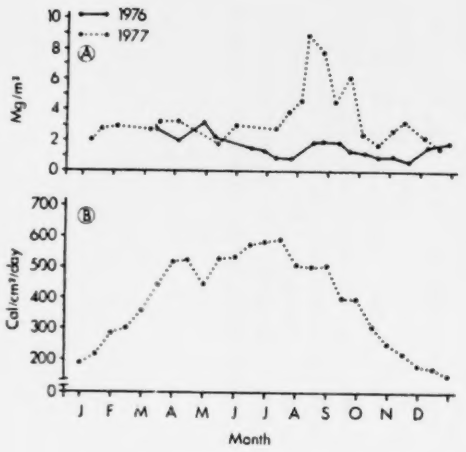
Phosphorus. Concentrations of orthophosphate-phosphorus (OP-P), the biologically usable form of phosphorus, ranged from 0.10 mg/l in February and March to 0.07 mg/l in September, averaging 0.0803 mg/l for 1976 (Kennedy, et al., 1977). The vertical distribution was similar to that of nitrate (Figure H-2). As is characteristic of saline lakes in arid regions, total phosphate levels remained high throughout the year, showing an average of 0.10 mg/l. Epilimnetic total phosphate varied only slightly from a maximum of 0.11 mg/l in March to a minimum of 0.8 mg/l in October (Kennedy, et al., 1977). Similar data are reported for 1977 by Galat, et al. (1979). Phosphorus is not considered limiting to algal growth in Pyramid Lake.

Phytoplankton. The phytoplankton (floating algae) in Pyramid Lake consists of diatoms (26 genera), blue-greens (3 genera), and one green algal species (Kennedy, et al., 1977; Koch, et al., 1976). Diatoms dominate the phytoplankton from about May to September. Total phytoplankton abundance in 1976 increased from less than 40 cells per milliliter (cells/ml) to over 390 cells/ml by early August. Blue-green algae began to appear in late July. All genera decreased to lower numbers by late August.

Even though Pyramid Lake's phytoplankton production compares similarly to other saline-alkaline lakes, it is actually relatively small per unit volume because of the lake's depth and thus great volume (Galat, et al., 1977). Using Liken's trophic category criteria, Galat, et al. (1977) placed Pyramid Lake in the mesotrophic category. While in a 1979 report (Galat, et al.) the lake is classified as oligotrophic saline. He also noted that whether it is mesotrophic or oligotrophic depends on classification criteria. Fish productivity is considered high, however, because of efficient energy transfer from producer to consumer.

Galat, et al. (1977) recently analyzed the lake's annual organic matter budget and estimated it at 72,952 metric tons of carbon (m.t C) or 0.789 grams of carbon per square meter per day (g C m^{-2} per day). Figures H-5a and H-5b show mean monthly relationships between solar radiation, chlorophyll-a and gross productivity. Phytoplankton contributed 90 percent of this productivity, with the remaining 10 percent being contributed by wind-blown vegetation (6.5 percent), the Truckee River (3 percent), and benthic plants (less than 1 percent).

5a



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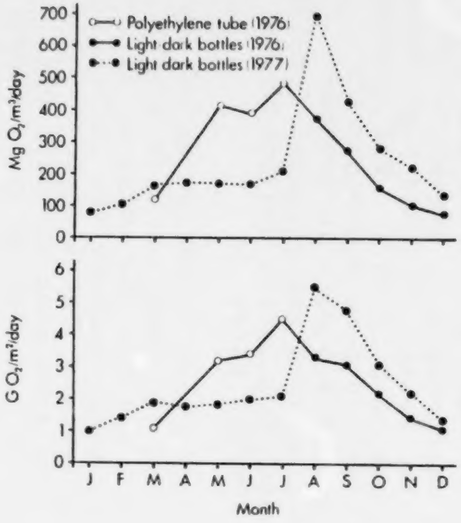
Dave Galat

5b



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Dave Galat

Figure H-5a. Mean limnetic chlorophyll-a concentrations (A) and total solar radiation, Pyramid Lake, Nevada.

Figure H-5b. Mean monthly limnetic gross photosynthesis, Pyramid Lake, Nevada.

SOURCE: Galat, pers. comm.

> "Much of Pyramid Lake's autochthonous[1] organic matter is produced during the annual summer Nodularia blooms (June-September). Living Nodularia is too large to be directly consumed by most Pyramid Lake zooplanktors. ...most of Pyramid Lake's allochthonous[2] productivity probably enters the detritus pathway. From here it is transferred to consumers (Figure H-6)" (Galat, et al., 1977).

Zooplankton. The zooplankton of Pyramid Lake consists of five species of cladocerans, one calanoid copepod, and one cyclopoid copepod (Kennedy, et al., 1977; Koch, et al., 1976). Kennedy, et al. (1977) found 75 percent of the zooplankton to be composed of copepods in 1976. Also, during that year, total zooplankton varied from a minimum of 21 individuals/liter in March to a maximum of 104 individuals/liter in June, with mean zooplankton numbers more than doubling in April (Figure H-7). Also see Galat, et al., 1979.

Benthic Macroinvertebrates. In 1976 the benthic macroinvertebrates susceptible to quantitative dredge sampling consisted primarily of oligochaetes (64.4 percent) and chironomids (33 percent). Present were at least one genus of oligochaete, five genera of chironomids, two amphipods and two odonates, an unidentified leech and an unidentified water mite (Kennedy, et al., 1977). The greatest abundance of oligochaetes was found in October (average = 1,216 individuals per square meter (individuals/m^2) and the lowest found in July (average = 549 individuals/m^2). Oligochaetes inhabited in greatest abundance zones ranging from 9-46 m and were least abundant from 0-8 m (Kennedy, et al., 1977). Chironomids were most abundant in April (average = 909 individuals/m^2) and least abundant in July. They were most numerous at 0-8 m (average = 656 individuals/m^2) and least numerous beyond 46 m (average = 10 individuals/m^2). Also see Galat, et al., 1979.

Bacteria (Thut, 1969, in Kennedy, et al., 1977) and detrital organic materials (Robertson and Alley, 1966, in Kennedy, et al., 1977), including organic matter from the Truckee River (Kennedy, et al., 1977), are probably the most important foods for the benthic macroinvertebrates.

Fish. The ten fish species in Pyramid Lake consist of the native cui-ui (*Chasmistes cujus*), a prehistoric remnant of the Pleistocene found only in Pyramid Lake; the native Lahontan cutthroat trout (*Salmo clarki henshawi*), largest of the cutthroat trout and a valuable game fish; the native

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[1] From within the lake.

[2] From outside the lake.

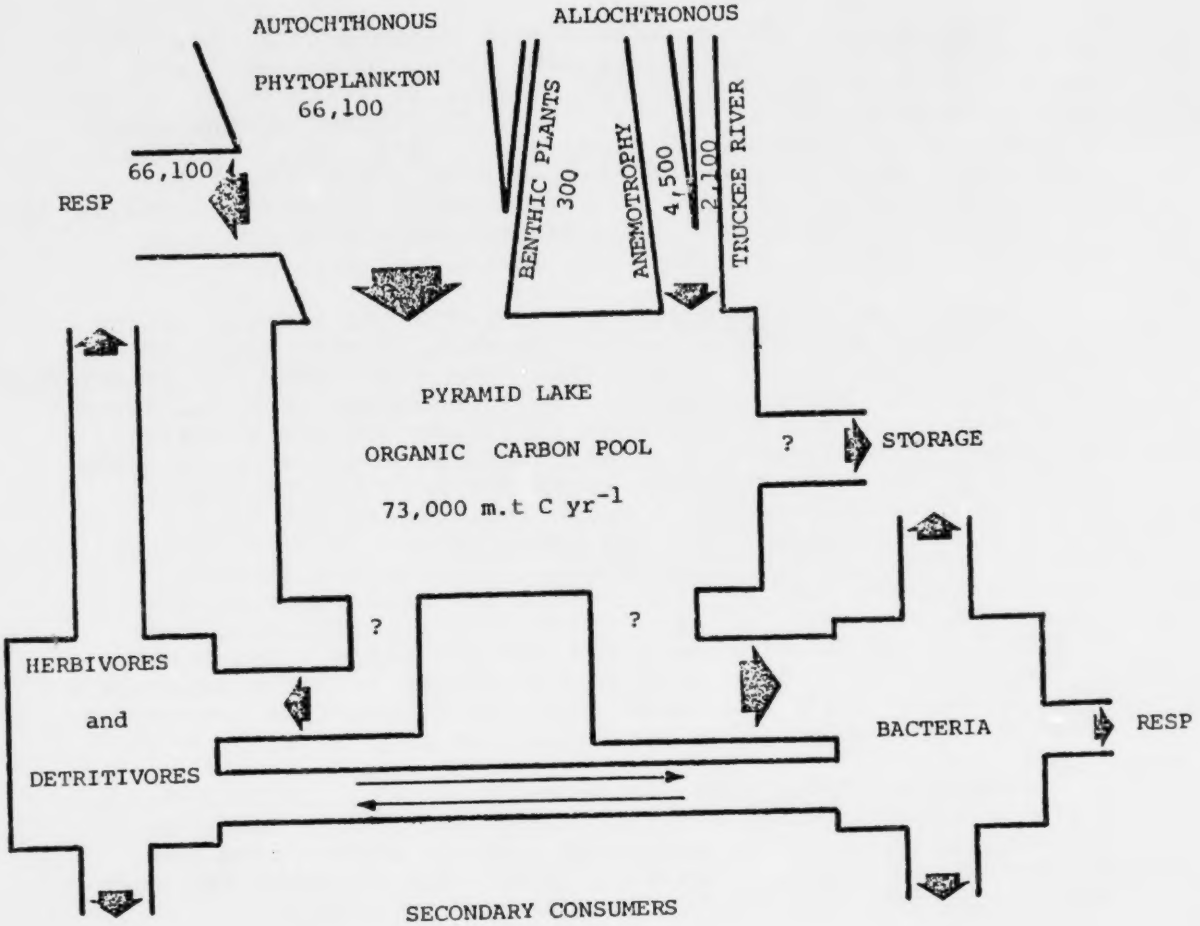

AUTOCHTHONOUS
ALLOCHTHONOUS
PHYTOPLANKTON
66,100
66,100
RESP
BENTHIC PLANTS
300
ANEMOTROPHY
4,500
2,100
TRUCKEE RIVER
PYRAMID LAKE
ORGANIC CARBON POOL
73,000 m.t C yr-1
?
STORAGE
?
?
HERBIVORES
and
DETRITIVORES
BACTERIA
RESP
SECONDARY CONSUMERS

Figure H-6. Generalized Relationships of Organic Carbon Flow to Pyramid Lake Secondary Consumers

SOURCE: Galat, McConnell and Hamilton-Galat, 1977.

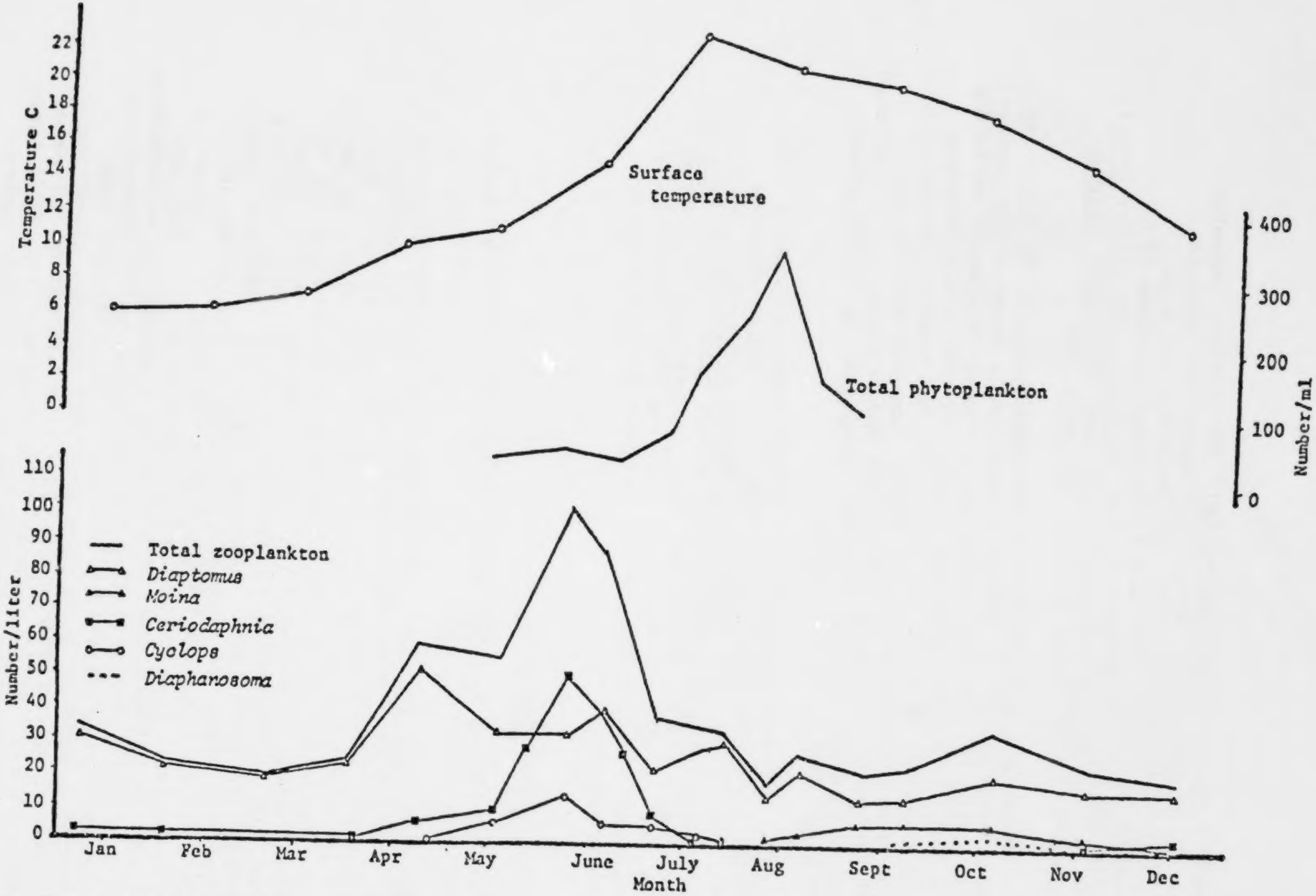


Figure H-7. Mean surface temperature, total phytoplankton, five species of zooplankton, and total zooplankton in Pyramid Lake, Nevada.

SOURCE: Kennedy, et al., 1977.

Tahoe sucker (*Catostomus tahoensis*); the native Lahontan tui chub (*Gila bicolor*); the native Lahontan redside (*Richardsonius egregius*); the native speckled dace (*Rhinichthys osculus*); and the introduced rainbow trout (*Salmo gairdneri*); Sacramento perch (*Archoplites interruptus*), mosquitofish (*Gambusia affinis*); and carp (*Cyprinis carpio*) (see Appendix 5, for life history information).

> "Recently a hydroacoustic survey conducted by W. F. Sigler and Assoc. (unpublished) documented Pyramid Lake's enormous fish population. Apparent high fish production in aquatic ecosystems may be due to a large food base, efficient transfer of this energy to higher trophic levels, or both. Our conclusion that Pyramid Lake does not receive or fix large amounts of energy, combined with the lake's reduced species diversity, low habitat heterogeneity, and a simplified trophic structure implies efficient energy transfer as the primary mechanism" (Galat, et al., 1977).

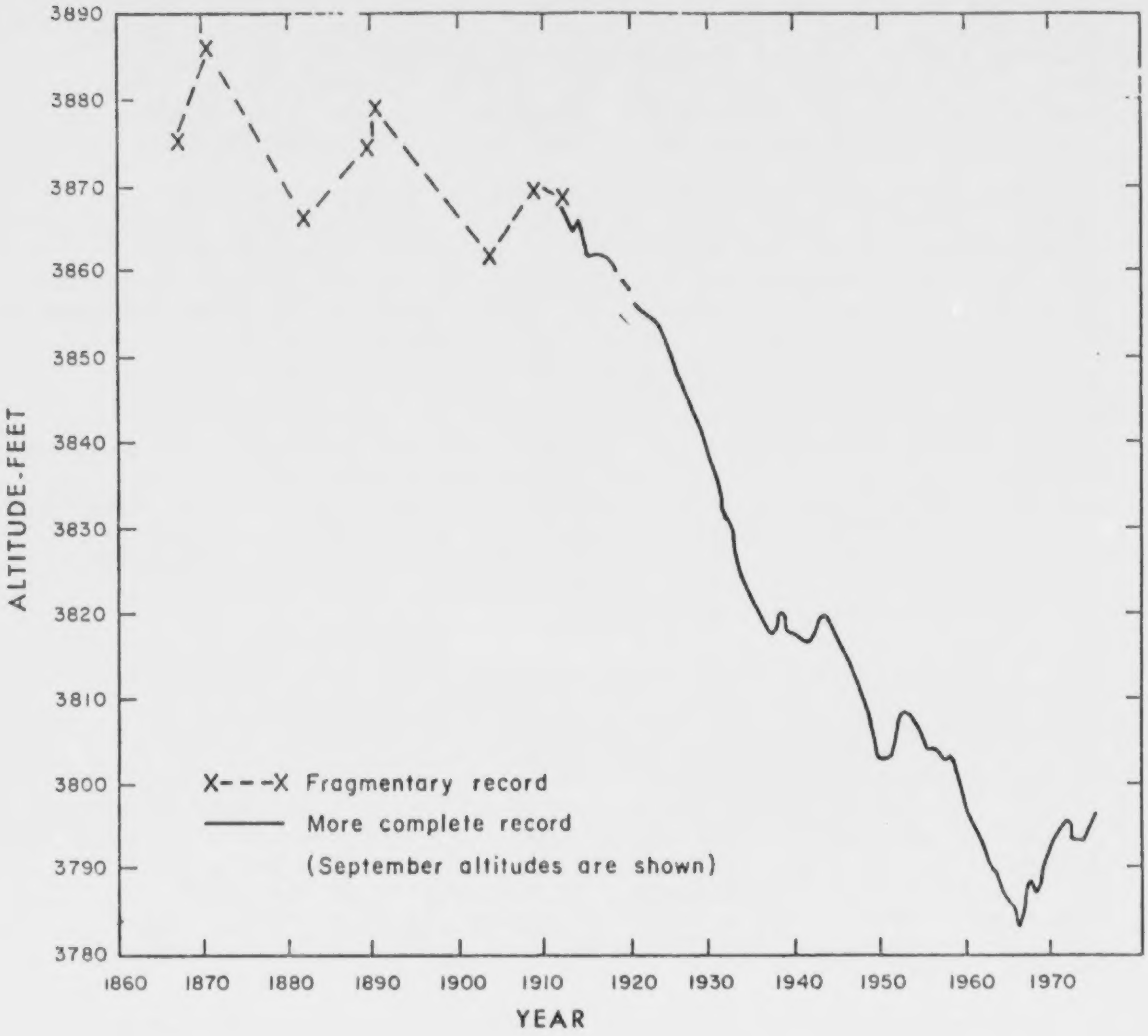
Birds. Several piscivorous birds rely on Pyramid Lake as nesting, rearing and feeding habitat. These species include: white pelican (*Pelecanus erythrorhynchos*), western grebe (*Aechmophorus occidentalis*), great blue herons (*Ardea herodias*), and common merganser (*Mergus merganser*). White pelicans are of special interest because the Pyramid Lake population of about 8,000 is the largest breeding colony in North America.

Major Ecological Concerns

The following are the major ecological concerns about the future of Pyramid Lake.

Insufficient Inflow. Following 1906 and the beginning of water diversion from the Truckee River for irrigation in the Carson River basin, the inflow to Pyramid Lake decreased by about one-half. This led to an accelerated decline in the lake level over what would be expected due to natural climatic fluctuation alone. Increased water uses upstream also contributed to reduced Truckee River flow and the decline in lake level. Between 1906 and 1967 the lake level receded about 24 m resulting from an annual water deficit between input and evaporation of about 475 thousand m^3 (Pyramid Lake Task Force, 1971) (Figure H-8). The lake recovered 3 m between 1967 and 1974 as a result of alterations in the operating criteria for Truckee River water diversions and increased precipitation. At its 1976 level the lake represented a drop of 21 m from its 1905 surface elevation and a loss of approximately 11 billion cubic meters of water (Kennedy, et al., 1977). Since 1976, however, the lake level has resumed its decline in response to the drought years.

Figure H-8. Water Surface Fluctuations of Pyramid Lake



SOURCE: U. S. Department of Interior, 1977.

Average annual flow of the lower Truckee River between Numana Dam (Figure H-9) and Pyramid Lake during 1929 and 1969 was 309,638,410 m^3 (251,000 acre-feet). This figure is based on records of the Federal Watermaster for the river below Numana Dam, plus the diversion at the dam, during 1929-57, and above the dam during 1958-69 (Glancy, et al., 1972). During this 41-year period of record the maximum annual flow was 128,296,390 m^3 (1,040,000 acre-feet) (water year 1952) and the minimum flow was 16,037,049 m^3 (water year 1931).

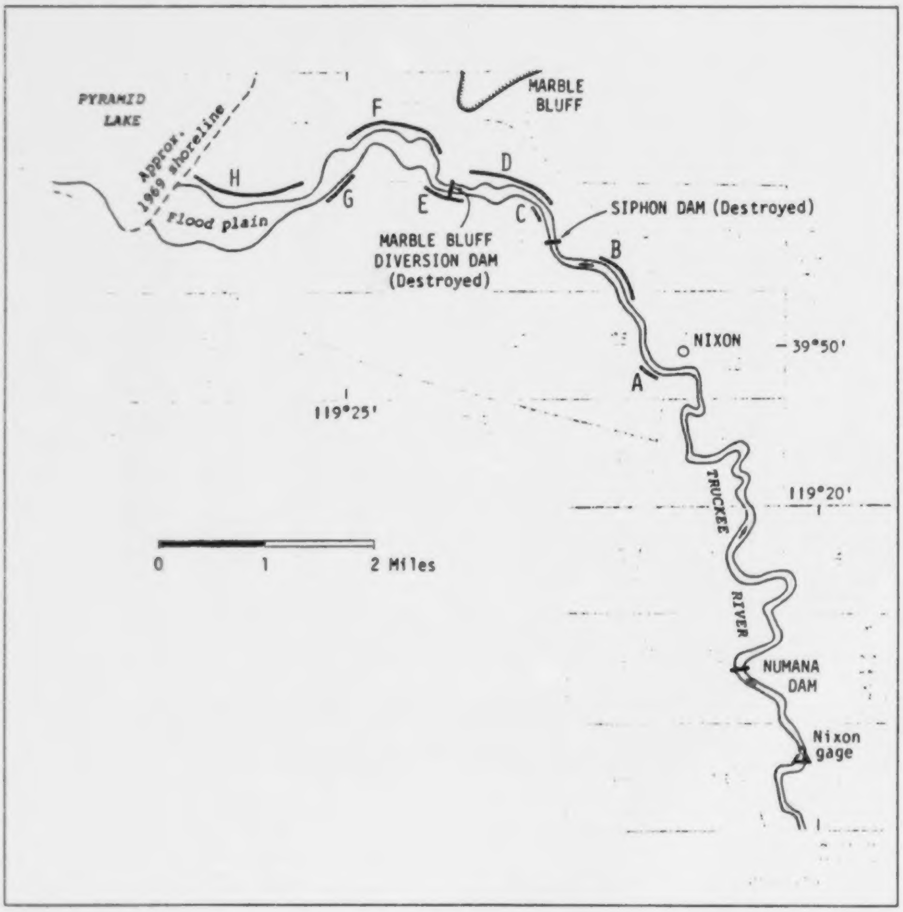
During water year 1969, the Truckee River flow at a gauging station about 14.5 km (9 miles) upstream from Pyramid Lake (Nixon gauge, see Figure H-9) was almost four times the long-term average for the 41-year period of record, exceeded only by the runoff in water year 1952. Because of this phenomenon, Glancy, et al. (1972) collected hydrologic data at this point to study the seasonal and areal character of stream flow, erosion, fluvial sediment movement, and solute transport, and then related these factors to physical characteristics of the basin, variations in climate, and the storage, release, and diversion of water. These hydrologic data were summarized and grouped according to periods of various stream flow conditions and compared with temperature and precipitation measurements recorded near Truckee, California, which served as conditions representative of the upper drainage basin where most of the runoff originated (Table H-2).

A useful generalized description of weather conditions and runoff characteristics in the Truckee River basin for the 1969 water year, but with general application to most water years, was also prepared (Table H-3). The pattern consists of an early period (October-December) of low flow, a short period (December-January) of minor low altitude flooding caused by rainfall, moderate to heavy flows from low altitude snowmelt and storage releases (January), a prolonged period of sustained high flows caused by a combination of high-altitude snowmelt and storage releases (January-June), and finally a return to low flows in late season (July) (Glancy, et al., 1972).

Increased Concentration of Solutes. Pyramid Lake water is currently highly ionic, being saline, alkaline, and basic. Nevertheless, the basic water chemistry of Pyramid Lake is quite stable in relation to chemical equilibria because the lake is a highly buffered bicarbonate system; this is confirmed by a pH which fluctuates only within a narrow range of about 8.8-9.4 throughout temporal changes that occur in the lake (Koch, et al., 1976).

Figure H-9

MAP OF NIXON AND VICINITY, SHOWING PRINCIPAL AREAS OF 1969 BANK EROSION (NOT TRUE TO SCALE) ALONG THE TRUCKEE RIVER


PYRAMID LAKE
Approx. 1969 shoreline
Flood plain
MARBLE BLUFF
H
G
F
E
D
C
B
A
SIPHON DAM (Destroyed)
MARBLE BLUFF DIVERSION DAM (Destroyed)
NIXON
39°50'
119°25'
119°20'
TRUCKEE RIVER
NUMANA DAM
Nixon gage
0
1
2 Miles

SOURCE: Glancy, et al., 1972.

Table H-2

SUMMARY OF PRECIPITATION AND AIR TEMPERATURE AT TRUCKEE, CALIFORNIA, AND HYDROLOGIC AND WATER QUALITY CONDITIONS FOR TRUCKEE RIVER NEAR NIXON, NEVADA
WATER YEAR 1969
(precipitation and air temperature for National Weather Service station at Truckee Ranger Station)

PERIOD NUMBER	PERIOD	TOTAL PRECIPITATION (in)	AVERAGE AIR TEMPERATURE (°C)	AVERAGE DISCHARGE (cfs)	TOTAL ACRE-FEET	ESTIMATED AVERAGE SUSPENDED-SEDIMENT CONCENTRATION (mg/l)	ESTIMATED TOTAL TONNAGE OF SUSPENDED SEDIMENT	AVERAGE SPECIFIC CONDUCTANCE (micromhos per cm at 25°C)	TOTAL TONNAGE OF SOLUTES[1]	TONNAGE OF SODIUM PLUS EQUIVALENT BICARBONATE AND CHLORIDE[1,2]
1	10-1 to 12-21	8.45	2.0	44	7,200	14	140	690	4,000	1,800
2	12-22 to 1-19	8.43	-3.5	480	27,500	40	1,500	300	7,200	2,500
3	1-20 to 1-31	15.47	-5.5	2,530	60,300	1,200	100,000	240	13,000	4,300
4	2-1 to 2-28	9.57	-5.0	1,630	90,600	210	26,000	180	15,000	4,700
5	3-1 to 3-31	1.56	-1.0	2,200	135,000	350	65,000	140	18,000	5,100
6	4-1 to 6-30	5.23	8.5	3,440	620,000	450	380,000	110	68,000	17,000
7	7-1 to 7-31	.90	16.0	430	26,300	81	2,900	210	4,900	1,700
8	8-1 to 9-30	.10	14.5	50	6,000	19	150	660	3,200	1,300
	ENTIRE YEAR	49.79	6.0	1,340	974,000	430	570,000	144	133,000	39,000

1. With bicarbonate multiplied by 0.492 to make results comparable with "residue on evaporation" values.

2. Tonnages are based on combined milligram-per-liter concentrations calculated as follows: sodium and chloride are totaled along with an amount of bicarbonate that is equivalent (on a reacting-value basis) to the amount by which sodium exceeds chloride; that is, me/l (milliequivalents per liter) HCO_3 = me/l Na - me/l Cl.

SOURCE: Glancy, et al., 1972.

Table H-3

A GENERALIZED SUMMARY OF RUNOFF CONDITIONS IN THE TRUCKEE RIVER BASIN DURING THE 1969 WATER YEAR

PERIOD	GENERAL WEATHER CONDITIONS	DOMINANT RUNOFF CHARACTERISTICS
Oct. 1-Dec. 21	Dry with short periods of minor precipitation	Seasonal low flows[1]
Dec. 22	---	Sharp increase in flow at Nixon gage because of reduced diversions through Derby Canal
Late Dec.-Jan. 17	Periods of snowfall; beginning of snowpack accumulation at high altitudes	No change
Jan. 18-21	Heavy basin-wide rainfall	Snowpack absorbed rain at high altitudes. Heavy runoff at low and middle altitudes, with appreciable overland flow and channel flushing
Jan. 22-24	Cessation of rainfall and rapidly falling temperatures	Receding flood runoff
Jan. 25-26	Warming temperatures, renewed rainfall	Renewed low-altitude runoff and localized small tributary flooding in lower parts of the basin
Jan. 27-mid March	All significant precipitation as snow; unusually heavy accumulations at high altitudes	Recession of late Jan. flooding, but generally high flows maintained by low- to medium- altitude snowmelt and increased reservoir releases
Late March-June	Some snowfall, with snowpack in mountains about 200% of average by April 1.[2] High-altitude melting beginning in April, with maximum melt during June. Periods of heavy rainfall during June	Heavy streamflow caused by contributions from uncontrolled small tributaries, combined with large lake and reservoir releases to accomodate heavy snowmelt inflow. Flooding of Truckee River near Tahoe City caused by rains[3]
Early July	Hot weather. Generally dry	Receding snowmelt runoff
Late July-Sept.	Warm to hot weather. Generally dry	Return to stable low-flow conditions

[1] U. S. Geol. Survey, 1970, p. 112-138.
[2] U. S. Soil Conservation Service, 1969, p. 1.
[3] U. S. Corps of Engineers, 1971, p. 13.

SOURCE: Glancy, et al., 1972.

It has been suggested (Lauer, 1933, in Robertson, 1978). that normally important controlling factors (e.g., temperature and dissolved oxygen) may not exert the same influence on aquatic populations in lakes of high salt content because of the overriding influence of salinity. More certain is the fact that high salinity reduces species diversity (Williams, 1972, in Galat, et al., 1977) which leads to less complex trophic relationships and potentially a less stable ecosystem. This more direct trophic structure also appears responsible for the efficient energy transfer which is the basis of the high fish production in Pyramid Lake (Galat, et al., 1977).

The deterioration of the Lahontan cutthroat trout and loss of the Sacramento perch fisheries in Walker Lake have been attributed to increased TDS levels (DOI, 1977). Bicarbonate and carbonate levels are believed to be limiting certain species of trout in Pyramid Lake (Knoll and Koch, unpublished data, in Koch, et al., 1976). Experimentation with fertilized eggs of the cui-ui incubated in Pyramid Lake water (salinity = 5.2 mg/l), in two dilutions of the lake water (salinities of 3.8 and 1.8 mg/l), and in fresh well water showed that although some cui-ui eggs could hatch in the lake water with a salinity close to 1.8 mg/l hatching success diminished as salinity approached 3.8 mg/l. Additionally, a significant decrease in egg size and mean total length of larvae occurred as salinity increased (Chatto, 1979).

The facts already presented concerning the recession of ancient Lake Lahontan to form Pyramid Lake and the climatic conditions conducive to a high rate of evaporation imply that increasing salinity, a corollary to a receding water level, is a natural phenomenon. Records do not indicate rate of change so it is a moot point. However, the lowered water inflow and salinity increase was accelerated between 1906 and 1967, widening the difference between the amount of water lost through evaporation and that entering from the Truckee River and from precipitation.

Since the beginning of the operation in Derby Dam in 1906, TDS has increased from 3,924 mg/l to the 1976 mean total concentration of 5,235 mg/l and ranges of 4,985 to 5,384 mg/l (Kennedy, et al., 1977). The major constituents are sodium, potassium, bicarbonate and chloride ions, with sodium and chloride dominating (Kennedy, et al., 1977). Sodium chloride accounted for 68 percent of this total in 1976 (Lider, pers. comm., in Vigg, 1978b).

Measurements of the concentration of dissolved solids in samples collected at the Nixon gauge during the 1969 water year ranged from 80 to 45 mg/l (Glancy, et al., 1972). The highest concentrations occurred during low flow periods when more than half of the dissolved solid load was contributed by saline groundwater entering from approximately 23 miles (37 km) upstream from Pyramid Lake. These low flow waters were dominated by sodium and almost equal amounts of calcium, bicarbonate, and chloride. The most dilute waters, consisting primarily of snowmelt, coincided with periods of highest flow. These dilute waters contained mostly silica, calcium, sodium, and bicarbonate (Glancy, et al., 1972).

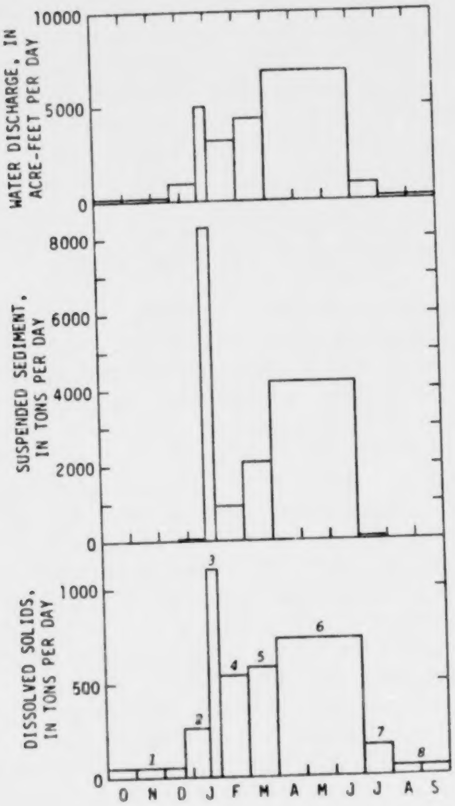
The solute load carried by the Truckee River past the Nixon gauge in 1969 ranged from 45.36 metric tons (50 tons) per day during low flow periods to about 997.90 metric tons (1,100 tons) per day during the latter part of January (period 3, Figure H-10 and Table H-2). The load averaged 662.25 metric tons (730 tons) per day during the period of April-June (period 6) when high flow was sustained. "The first major runoff of the year tends to flush out solutes that have become available during the previous period of low flow" (Glancy, et al., 1972). The total load for 1969 was about 117,934.05 metric tons (130,000 tons). This total annual solutes load is about one-fifth of the sediment load for the year.

According to Glancy, et al. (1972), the amount of sodium plus equivalent bicarbonate and chloride contributed by the Truckee River to Pyramid Lake during water year 1969 (when total flow passing the Nixon gauge was almost four times the long-term average) was almost 36,287.40 metric tons) (40,000 tons). This is 30 percent of the total solute load passing the Nixon gauge. Based on these and other data, Glancy, et al. (1972) estimated the quantity of solutes passing the gauge in an average year to be 40,823.33-49,895.18 metric tons (45,000-55,000 tons) and the average concentration to be about 150 mg/l. The average annual contribution of the principal lake components that play a role in the solute balance of the lake, sodium plus equivalent bicarbonate and chloride, may total 16,329.33-19,958.07 metric tons (18,000-22,000 tons). This estimated annual average income of principal solutes from the Truckee River to Pyramid Lake is equal to about one seven-thousandth of the lake's current salt content of 127.01 million metric tons (140 million tons).

Because solutes contributions from the Truckee River would increase the tonnage in Pyramid Lake by less than 1½ percent in 100 years at present day rates of income (Glancy, et al., 1972), it appears evident that the primary cause of salinity increase in Pyramid Lake since 1905 has been solute concentration accompanying evaporative water loss.

Figure H-10

STREAM FLOW, SUSPENDED-SEDIMENT LOAD, AND SOLUTE LOAD CARRIED BY TRUCKEE RIVER NEAR NIXON DURING WATER YEAR 1969 (numbers correspond with periods listed in Table H-2)



SOURCE: Glancy, et al., 1972.

Blue-Green Algae. The blue-green algae Nodularia spumigena typically forms late summer algal blooms in Pyramid Lake. However, it does not appear to produce any toxins that are detrimental to any of the lake biota, including zooplankton or other algae (Koch, et al., 1976), nor does it create life-threatening anoxic conditions during decomposition. The only detrimental effect the algae appears to exert is the physical stress of crowding on zooplankton and larval fish (Koch, et al., 1976). Both field and laboratory investigations showed that Moina hutchinsoni, a preferred food for planktivorous fish during these months when Nodularia blooms, reproduces well and occurs in the presence of Nodularia (Figure H-11).

There is little historical data on nutrient loading to Pyramid Lake. Data on nitrogen and phosphorus concentrations in the lake prior to 1973 are nonexistent. However, some general knowledge is available regarding current sources and concentrations of major nutrients.

Nitrogen. Autochthanous nitrogen soures are primarily nitrogen fixation by blue-green algae and subsequent mineralization. Allochthanous sources are primarily importations from the Truckee River, precipitation, and windblown dust and vegetation. However, it is not known how much of the nitrogen entering the lake is converted to biologically usable nitrate (NO_3) (Galat, pers. comm.). Nitrogen is a limiting nutrient for algae; consequently, any inflow of soluble nitrogen is expected to quickly enter the photosynthetic process.

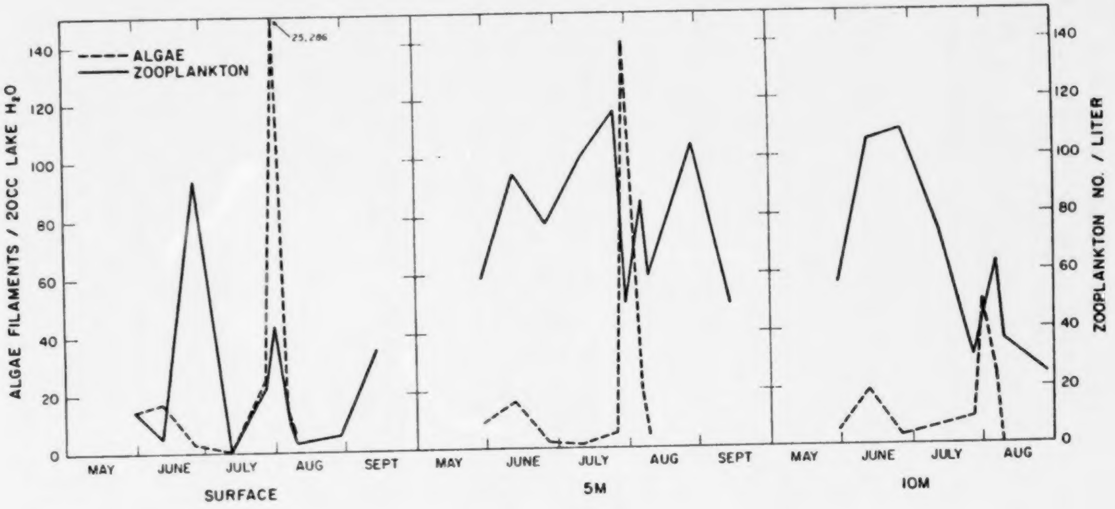
Phosphorus. The major source of phosphorus is most likely geologic as phosphorus deposits occur all around the lake. However, it is not known how much of this is transformed into biologically useful orthophosphate (Galat, pers. comm.). Phosphorus is not considered a limiting nutrient.

Although no reliable work has been done to support the belief, much indirect evidence points to nitrate as the primary limiting nutrient in Pyramid Lake, except for the nitrogen-fixing blue-green algae (Galat, pers. comm.). Culture experiments on Nodularia showed it to be phosphorus-limited in Pyramid Lake water. However, orthophosphate does not disappear from the water during Nodularia blooms as would be expected if it were limiting in the lake.

> "It is my opinion that phosphates in part limit Nodularia in Pyramid, but other factors, primarily temperature, are equally important. Nitrates and silicates appear to be the probable limiting nutrients for other Pyramid Lake algae. Generally

Figure H-11

COMPARATIVE POPULATION SIZES OF ZOOPLANKTON AND THE ALGAE
NODULARIA SPUMIGENA IN PYRAMID LAKE, 1974



SOURCE: Koch, Hoffman and Mahoney, 1976.

speaking, PO_4 levels in Pyramid are quite high while NO_3 concentrations are quite low. Pyramid's inorganic-N to ortho-P ratio of 1:2 further suggests NO_3 as the dominant limiting nutrient to non-nitrogen fixing algae" (Letter from D. Galat, Colorado Cooperative Fish Unit, 22 December, 1978, to R. Ryder, Pacific Environmental Laboratory).

Iron is also known to be a limiting nutrient for blue-green algae; soluble iron is in low concentrations in the lake.

Nodularia blooms are not a recent phenomenon and it has been reported that local Indians historically dried Nodularia for sleeping mats (Letter from D. Galat, Colorado Cooperative Fish Unit, 22 December 1978, to R. Ryder, Pacific Environmental Laboratory). A Nodularia bloom did not occur in 1976 and was instead replaced by Chaetoceros as the dominant form in Pyramid Lake during late summer (Kennedy, et al., 1977).

Nutrient Loading. As a terminal lake, concentrations of nutrients in Pyramid Lake can only increase. Large nitrogen and phosphorus reservoirs are maintained in the flora and fauna and detritus in the Truckee River, and normal decomposition releases these nutrients in amounts that vary with season. Additionally, these nutrients, especially those stored in detrital materials and plants below Derby Dam, can greatly augment the average loadings to the lake during scouring following heavy runoff. For example, Glancy, et al. (1972) found the heavy runoff in water year 1969 to cause extensive erosion in the Truckee River basin. Scouring of the river moves stored organic matter downstream into the lake. This load accounts for an undetermined part of the allochthonous carbon, and also nutrient inflow, illustrated in Figure H-6. Although dissolved nitrogen and other micronutrients flowing into the lake may enter almost immediately into the energy flow, organic materials are metabolized in the lake and entry into the steady-state energy flow may require considerable time. It seems appropriate to conclude that any nutrient inflow accelerates eutrophicative processes in the lake.

Sediment Loading. Glancy, et al. (1972) estimated the cumulative annual suspended-sediment load passing the Nixon gauge to be about 51,709.55 metric tons (57,000 tons). Sediment bedload, which is not measured by suspended-sediment sampling, was assumed to have been about 10 percent of the suspended-sediment load, or about 54,431.10 metric tons (60,000 tons). The total sediment load passing the gauge was therefore estimated at about 571,526.55 metric tons (630,000 tons) for water year 1969.

> "The total load would be equivalent to upstream erosion of about 420,000 cu. yd. (cubic yards) of material, assuming an average in-place sediment density of about 1.5 tons per cu. yd. (110 lbs. per cu. ft.). The sediment originated upstream from the Nixon gauge and mainly downstream from the major storage reservoirs or from about 1,210 square miles of the basin. Therefore, the net annual sediment-yield rate from above the Nixon gauge was about 520 tons (350 cu. yd.) per square mile" (Glancy, et al., 1972).

High sediment concentrations and loads during January 20 to 31, 1969, were caused mainly by rainfall and subsequent rapid overland runoff, whereas sediment concentrations and loads during February 1 through June 30, and particulary in April, May, and June, were caused primarily by persistent channel scouring resulting from sustained high flow.

Glancy, et al. (1972) estimated the amount of streambank erosion at locations where it appeared greatest (Table H-4). Total streambank erosion between Nixon and the lake accounted for approximately 3,654,134 m^3 of sediment, more than 10 times the amount of sediment estimated to have passed the gauge upstream from Nixon. Assuming the same unit weight of 1.5 tons per cu. yd. (approximately 1.8 metric tons per m^3) for the in-place deposits as was assumed for materials eroded above the Nixon gauge, the 3,654,134 m^3 of sediment is equivalent to about 6,168,858 metric tons (6,800,000 tons).

Loss of Native Fishes. Prior to 1905 and the construction of Derby Dam, Pyramid Lake supported a productive fishery consisting of many large Lahontan cutthroat trout and the cui-ui lake sucker. Historically these fish were a major food for the Indians who did not engage in extensive agriculture (Pyramid Lake Task Force, 1971). However, by 1929 the Lahontan cutthroat and cui-ui could no longer migrate up the Truckee River where they traditionally spawned. The decline in lake level and reduced Truckee River flow had combined to create a silt delta at the river mouth with insufficient water depth in delta channels to permit fish navigation. By 1940 the Lahontan cutthroat fishery was nonexistent and the cui-ui was reduced to the status of an endangered species (Pyramid Lake Task Force, 1971).

The cui-ui was first listed as an endangered species in the Federal Register on March 11, 1967. A recovery team has been assigned for this species, although critical habitat is still under consideration by the U. S. Fish and Wildlife Service (USFWS). Although the cui-ui was once abundant, it now comprises less than 1 percent of the fish in Pyramid Lake (Letter from K. Schreiner, Acting Director USFWS,

Table H-4

ESTIMATES OF CHANNEL EROSION FROM MAJOR SOURCE AREAS ALONG THE TRUCKEE RIVER DOWNSTREAM FROM THE NIXON GAUGE

EROSION SITE[1]	ESTIMATED AREA ERODED (acres)	ESTIMATED AVERAGE THICKNESS (feet)[2]	ESTIMATED VOLUME ERODED (acre-feet)
SEVERAL SMALL AREAS[3]	a 15	10	150
A	b 2	15	30
B	b 34	10	340
C	b 5	20	100
D	b 26	25	650
E	c 12	40	480
F	c 60	10	600
G	c 18	10	180
H	c 28	10	280
TOTAL (rounded)	200	--	2,800

1. Approximate locations shown in Figure G-6.
2. Field estimates using bank heights measured by P. A. Glancy in spring of 1970.
3. Throughout 2-mile reach upstream from Nixon Bridge.

a. Field estimates by P. A. Glancy in spring of 1970, with assistance by local landowners.
b. Area determined by Bureau of Indian Affairs and furnished by J. W. Long (written commun., 1970).
c. Area determined by S. M. Born using 1968 and 1969 aerial photographs.

SOURCE: Glancy, et al., 1972.

23 August 1978, to D. Costle, Administrator EPA) (Table H-5). Except for spawning in the lower Truckee River between the lake and Derby Dam, the cui-ui's habitat consists of the littoral zone of the lake, mainly at depths of 0-5 m (Vigg, 1978a, in Vigg, 1978b). It has rarely been found at 23 m, never deeper than 46 m, and the only surface catches have occurred during the spring spawning season (Vigg, 1978a, in Vigg, 1978b).

The Lahontan cutthroat trout population was at one time large enough to support a large commercial fishery. However, the fish was listed as an endangered species on October 13, 1970. It was later reclassified as a threatened species on July 16, 1975. Critical habitat has not yet been determined for this species either. Although the largest population of the Lahontan cutthroat currently exists in Pyramid Lake, known primary distribution of the fish also includes Summit, Independence and Walker Lakes, and streams in the Lahontan Basin and along the western slope of the Sierra Nevada (Letter from K. Schreiner, Acting Administrator USFWS, 23 August, 1978, to D. Costle, Administrator, EPA). Lahontan cutthroat were found predominantly on the bottom throughout 1977, but they apparently prefer areas ranging in temperature between 7°C and 15°C (Vigg, 1978a, in Vigg, 1978b) (Table H-5).

In attempting to reestablish the Pyramid Lake fishery, Congress passed the Washoe Project Act in 1956. This led to the construction of Marble Bluff Dam and Fishway at the mouth of the Truckee River by the Bureau of Reclamation to provide a passage around the delta for spawning fish and help control erosion. Together with related work, the Washoe Project has also supplied hatchery-produced fish for supplemental stocking. As a result, the Lahontan cutthroat trout population has increased and contributes significantly to the lake's sports fishery by producing trophy-sized fish. The cui-ui, on the other hand, were found to be considerably less abundant in 1969 than previously and during the fall of that year the Indians closed the fishery to non-Indians. Good progress has been made, however, with recent artificial spawning procedures to return juvenile cui-ui to the lake to strengthen the existing population. Criteria for effective management of this resource are currently being established (DOE, 1977).

In addition to the cui-ui and Lahontan cutthroat, the bottom (23 m) inshore area of Pyramid Lake is the habitat for three other fish species; Lahontan tui chub, Tahoe sucker, and the Sacramento perch. In contrast to this diversity in the inshore bottom area, the tui chub alone accounted for over 98 percent of sampling catches in inshore surface and offshore open-water areas in 1977; the remaining 2 percent consisted primarily of the Lahontan cutthroat (Vigg, 1978b).

Table H-5

FISH CATCH IN THE SURFACE (3.66 x 76.2 m gill net) AND BOTTOM (1.82 x 76.2 m gill net) ZONES AT THE 23 m DEPTH CONTOUR OF PYRAMID LAKE FROM JUNE THROUGH NOVEMBER 1977

		Species					
Depth zone	Catch statistic	Cutthroat trout	Cui-ui	Tahoe sucker	Tui chub	Sacramento perch	Total
Surface	Number	47	0	2	2,657	1	2,707
	Catch/net	1.34	0	0.06	75.91	0.03	77.34
	Percent by species	1.7	0	0.07	98.2	0.04	100
	Percent by depth	14.8	0	0.03	57.4	25.0	48.4
Bottom	Number	270	10	631	1,975	3	2,899
	Catch/net	7.71	0.29	18.03	56.43	0.09	82.54
	Percent by species	9.3	0.4	21.8	68.4	0.1	100
	Percent by depth	85.2	100	99.7	42.6	75.0	51.6

SOURCE: Vigg, 1978b. Vertical distribution of fish in Pyramid Lake, Nevada. Great Basin Naturalist. 38:417-428.

The tui chub is the principal food for the Lahontan cutthroat trout. Because of its high relative abundance and hypothesized trophic importance the tui chub is believed to be a key component in the ecosystem bioenergetics of Pyramid Lake. The reproductive biology of the tui chub in the lake has been recently studied and documented (Kucera, 1978). The Tahoe sucker lives almost exclusively on the bottom (Table H-5) (Kucera, 1978). A study of the reproductive ecology of the Tahoe sucker has been recently published (Kennedy and Kucera, 1978). The seasonal pattern of distribution for the Sacramento perch was found to be similar to that of the cui-ui (Vigg, 1978a, in Vigg, 1978b).

Lahontan cutthroat, cui-ui, and tui chub manifest diel changes in vertical inshore distribution associated with surface water temperature. However, the response of tui chubs to the temperature regime appears to be essentially opposite that of the cutthroat trout (Table H-5) (Vigg, 1978b).

> "The fact that I observed maximum cutthroat trout densities in vertical strata exhibiting relatively low temperature ranges may be attributed to a lower temperature preference of the Lahontan cutthroat subspecies, or synergistic interaction between temperature and the high alkalinity levels of Pyramid Lake. Preliminary evidence indicates that as alkalinity concentration increases from the level of fresh water (<100 mg/l) to Pyramid Lake water (>1,400 mg/l), the lethal temperature range is considerably lowered" (Vigg and Koch, 1978, in Vigg, 1978b).

Although high surface water temperatures interact with hypolimnetic oxygen deficits during summer to restrict cutthroat trout to a narrow zone in the vicinity of the thermocline[1] in Walker Lake (Cooper, 1978, in Vigg, 1978b), dissolved oxygen concentrations low enough to restrict fish distribution in Pyramid Lake were found only in the deepest region during late fall prior to lake overturn (Vigg, 1978b). Lowest dissolved oxygen levels occur during and after Nodularia blooms and last for only a short time; anaerobic conditions are not reached in Pyramid Lake (Koch, Benson and Mahoney, unpublished data, in Koch, et al., 1976).

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[1] Zone where temperature increases approximately 1°C per meter.

The vertical distribution of the tui chub in open water corresponds to the distribution of the zooplankton it selects in its diet (Figure H-12). The population of tui chubs inhabiting the open-water area in the lake consists almost exclusively of zooplankton feeders (Vigg, 1978b). However, Koch, et al. (1976) believe that the tui chub, as well as the Sacramento perch, gradually change to feeding on other fish. The three apparent food preferences throughout 1977 were *Ceriodaphnia quadrangula* (June), *Cyclops vernalis* (July), *Moina hutchinsoni* (August, September, October).

Daily activity patterns and vertical distribution for tui chub and cutthroat during June (Figure H-13) and August (Figure H-14) were assessed from samplings at 23 m off Cormorant Rock in 1977 (Vigg, 1978b). Although tui chubs were found predominantly on the surface and cutthroat predominantly on the bottom throughout the day, consistent changes in distribution occurred with respect to time of day.

Threat to Anaho Island Fauna. Anaho Island is a national wildlife refuge within Pyramid Lake. It is administered by the USFWS for the purpose of protecting colonial nesting birds. Of the total of 303.5 ha occupied by the island, 100 ha are devoted to the refuge. The island has one of the largest white pelican colonies in the United States. Also inhabiting the island are colonies of double crested cormorants, California gulls, great blue herons and Caspian terns. The total summertime population of waterbirds reaches approximately 15,000 individuals (DOI, 1977).

The declining lake level has exposed more of the island. Whether these areas can be considered a part of the refuge or are technically part of the Indian reservation is as yet undetermined. Most of the bird nesting occurs on these recently exposed areas. Additionally, a natural land bridge connecting the island to the shore now lies only about 9 m below the water surface. Exposure of the bridge would enable both humans and natural predators access to the island, posing a threat to the continued existence of the bird rookeries and to the various other animal inhabitants (DOI, 1977).

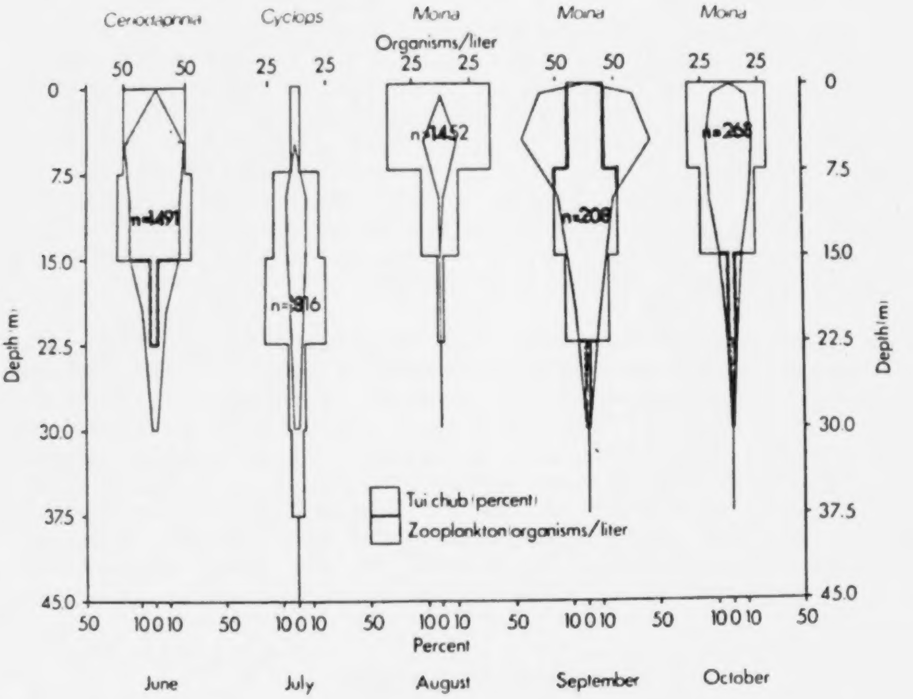
Lahontan Reservoir

Introduction

Lahontan Reservoir (Figure H-15) is located in the Carson River channel approximately 72 km (45 miles) southeast of Reno. It is 27 km (17 miles) long and of variable width.

Figure H-12

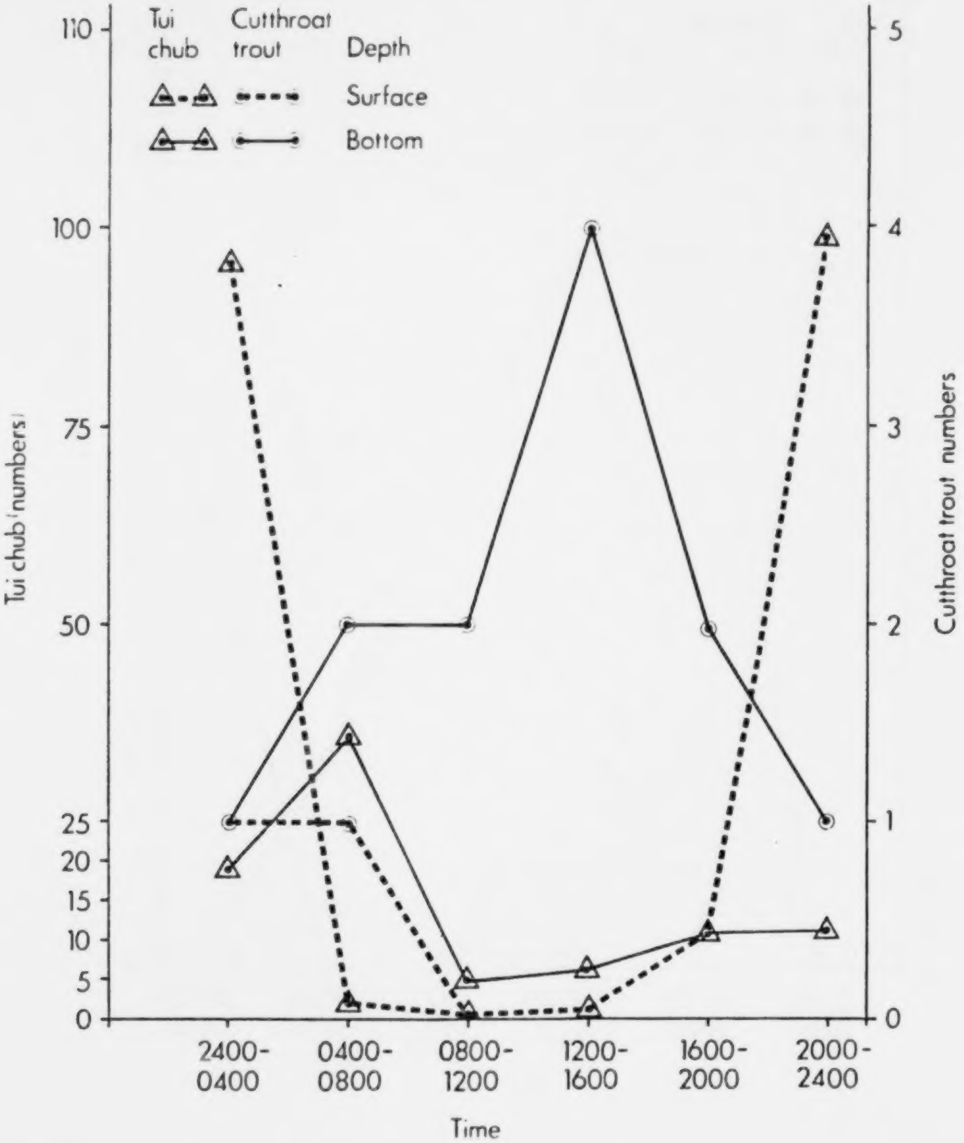
VERTICAL LIMNETIC DISTRIBUTION (percent by depth interval) OF TUI CHUB IN PYRAMID LAKE, NEVADA, FROM JUNE THROUGH OCTOBER 1977 IN RELATION TO THE VERTICAL DISTRIBUTION (density by depth interval) OF THE ZOOPLANKTON TAXON SELECTED IN THE DIET OF TUI CHUBS



SOURCE: Vigg, 1978b.

Figure H-13

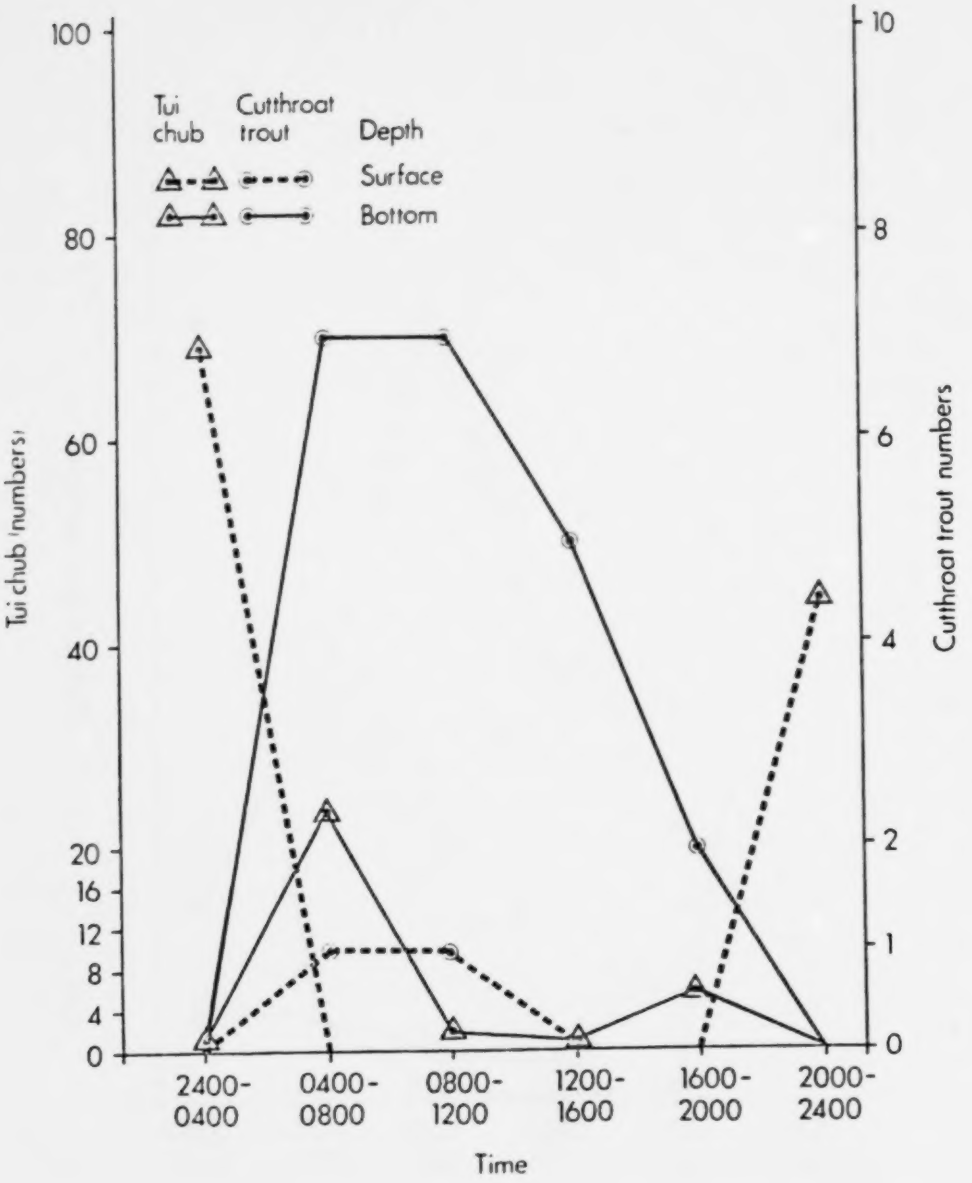
DIEL ACTIVITY AND VERTICAL DISTRIBUTION PATTERNS OF TUI CHUB AND CUTTHROAT TROUT AT THE 23 m DEPTH IN THE VICINITY OF CORMORANT ROCK, PYRAMID LAKE, NEVADA DURING JUNE 1977



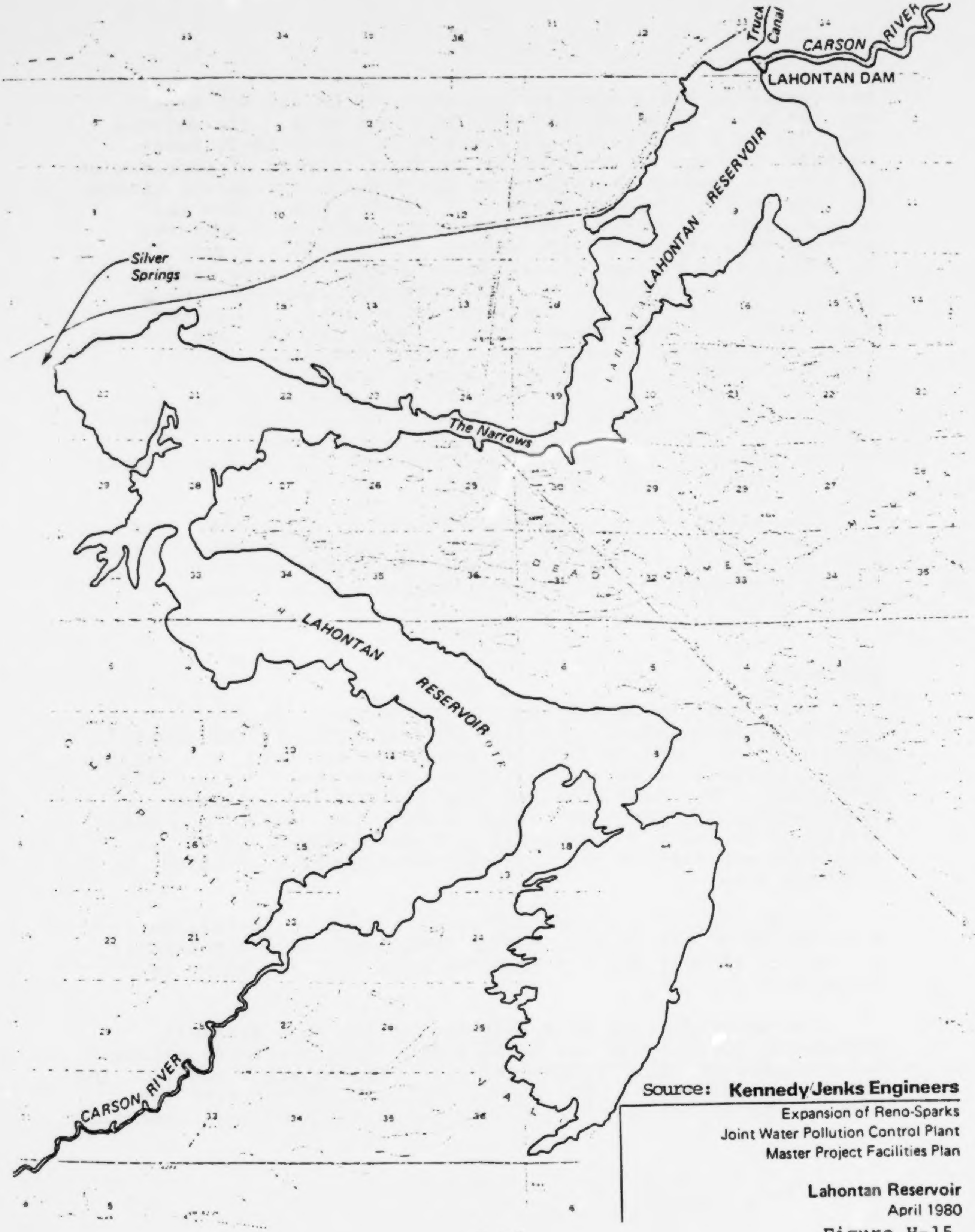
SOURCE: Vigg, 1978b.

Figure H-14

DIEL ACTIVITY AND VERTICAL DISTRIBUTION PATTERNS OF THE TUI CHUB AND CUTTHROAT TROUT AT THE 23 m DEPTH IN THE VICINITY OF CORMORANT ROCK, PYRAMID LAKE, NEVADA DURING AUGUST 1977



SOURCE: Vigg, 1978b.


Truck Canal
CARSON RIVER
LAHONTAN DAM
LAHONTAN RESERVOIR
Silver Springs
The Narrows
LAHONTAN RESERVOIR
CARSON RIVER

Source: **Kennedy/Jenks Engineers**

Expansion of Reno-Sparks
Joint Water Pollution Control Plant
Master Project Facilities Plan

Lahontan Reservoir
April 1980

Figure H-15

The reservoir has a surface area of 5,099 ha (12,600 acres) and 104.5 km (65 miles) of shoreline when full. Its maximum depth is 34 m (112 feet) and averages 4.5-6 m (15-20 feet). Lahontan Dam was constructed by the U. S. Bureau of Reclamation in 1915 to impound the waters of the Truckee and Carson Rivers for use in the Newlands Project of the Truckee-Carson Irrigation District (TCID). The reservoir contains a designed storage capacity of 295,100 acre-feet. Lahontan Reservoir, in addition to storage of irrigation water, is also used extensively for recreation. The reservoir supports a major recreational fishery for the surrounding area. Sought-after fish species include rainbow trout, bass, catfish, and sunfish. Other recreational uses include boating and water contact sports. Recently, it has been managed for flood protection. Lahontan Reservoir is not presently used as a municipal or domestic water supply source; however, the state has designated it as a potential future drinking water supply. The actual feasibility of using this water for public water supply is the subject of an on-going study.

The water stored in Lahontan Reservoir originates from the Carson River and the Truckee River via diversions created by Derby Dam and the Truckee Canal. An historical account of the development of Lahontan Reservoir can be found in DOI (1977).

Limnology

Water quality data available for Lahontan Reservoir consist of measurements obtained at four sites by the Nevada Department of Wildlife (NDW) between 1966 and 1967, and samples from 3-4 depths at three sites taken three times during 1975 by the EPA. The data obtained from the NDW and EPA have been summarized (Table H-6 and Figure H-16). Additional data are given in Table H-7 prepared by Kennedy/Jenks. The following description of the reservoir limnology is based on these data.

Water quality standards adopted in 1967 by the Nevada State Board of Health (now Nevada Department of Environmental Protection [NDEP]) for the Lahontan Reservoir are shown in Table H-8.

The water quality data obtained by EPA show seasonal changes in DO, pH, and the algal-stimulating nutrients nitrogen and phosphorus, which correspond with temperature stratification and destratification. The water quality parameter with the greatest potential significance to the biology of the reservoir

Table H-6

SUMMARY OF AVAILABLE ALGAL NUTRIENT DATA FOR LAHONTAN RESERVOIR
(From 7/66-5/76)

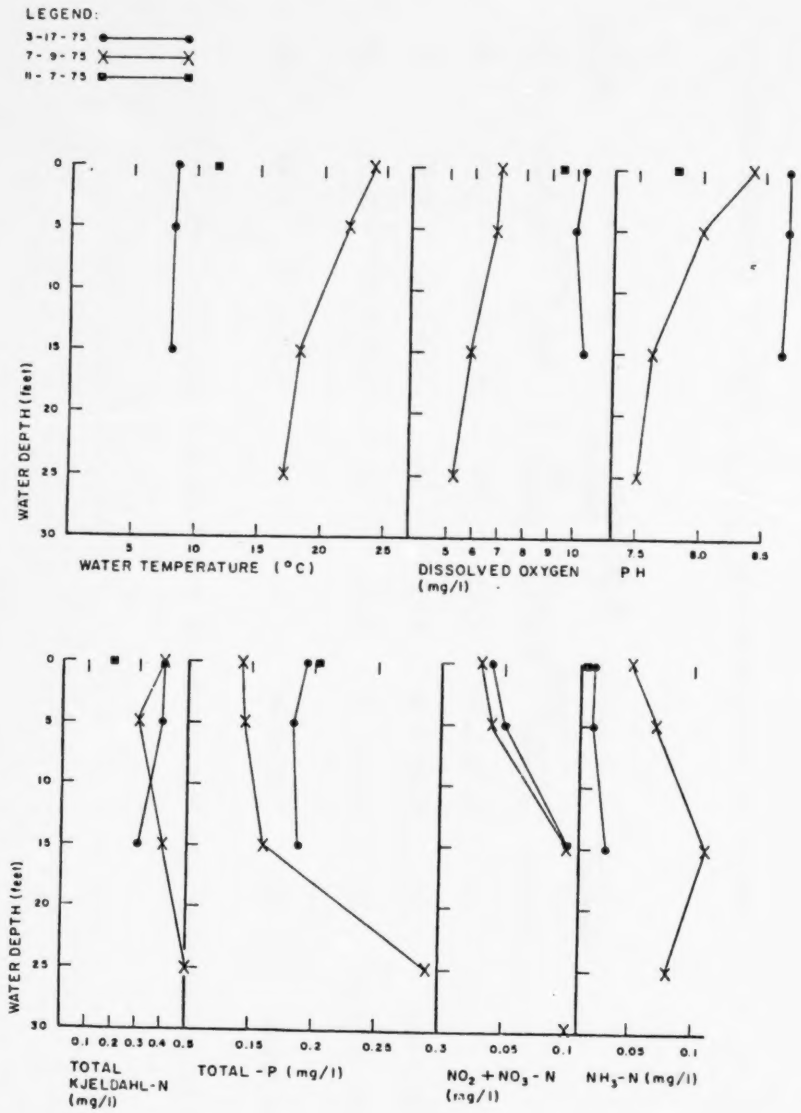
Station	Phosphates						Nitrate		
	Number of Samples	Total		Number of Samples	Ortho		Number of Samples		
		Range	Average		Range	Average		Range	Average*
Near Dam	19	0.30-1.60	1.11	14	0.28-1.55	0.69	20	Neg.-10.5	1.72
Near the Narrows	19	0.14-1.36	0.53	14	0.13-1.05	0.49	20	Neg.-4.8	1.33
Near Silver Springs Beach	18	0.20-1.06	0.56	14	0.23-0.85	0.55	19	Neg.-4.8	1.16
Near River Mouth	15	0.28-0.80	0.51	12	0.28-0.76	0.48	15	Neg.-1.7	0.63

*Averages are calculated with concentrations reported as trace, neg., and <0.4=0.

SOURCE: Vasey-Scott Engineering, 1978.

Figure H-16

VARIATIONS OF WATER QUALITY PARAMETERS
IN
LAHONTAN RESERVOIR AT EPA STATION 320204



SOURCE: Vasey-Scott Engineering, 1978.

Table H-7. Lahontan Reservoir Water Quality (1)

Parameter	Units	Near Carson River Mouth Conc.	Near Carson River Mouth # of Samples	Silver Springs Conc.	Silver Springs # of Samples	East End of Narrows Conc.	East End of Narrows # of Samples	Near Lahontan Dam at North End Conc.	Near Lahontan Dam at North End # of Samples
Total-P	mg/l	0.19	8	0.23	17	0.22	20	0.18	19
Total PO_4-P	mg/l	0.17	19	0.18	23	0.18	23	0.23	16
Ortho-P	mg/l	0.15	15	0.17	18	0.16	19	0.24	20
Diss. Ortho-P	mg/l	0.11	8	0.15	13	0.15	17	0.15	16
NH_3-N	mg/l	0.004	13	0.04	24	0.02	27	0.04	28
NO_3-N	mg/l	0.16	22	0.34	32	0.49	33	0.42	24
NO_2-N+ NO_3-N	mg/l	0.17	8	0.28	13	0.33	17	0.35	16
Total Kjeldahl-N	mg/l	0.36	8	0.23	13	0.25	17	0.28	16
Organic-N	mg/l	0.2	1	0.44	6	0.23	6	0.40	6
BOD_5	mg/l	2.83	12	1.5	17	1.3	16	1.8	31
TDS	mg/l	164	22	163	30	168	30	162	20
pH	Unit	7.5-8.8	22	7.6-8.6	29	7.6-8.9	35	7.3-8.7	35
Temp.	°C	8.0-28	23	7.1-25	30	6.2-25	32	5.7-23.5	33

(1) Average of following data sources:

1. EPA, Region IX, "Water Quality Data, Truckee and Carson Rivers, Pyramid Lake, and Lahontan Reservoir, A Working Paper", 1971 (Sampling Period 1966, 1968).
2. EPA water quality data stored in STORET computer data retrieval system, 3/17/75 - 11/7/75.
3. State of Nevada, Dept. of Environmental Protection water quality data stored in STORET, 7/66 - 5/76.
4. DRI, water quality data stored in computer, 7/66 - 9/71.

Apparent discrepancies in concentrations of certain constituents (e.g., NO_3-N and NO_2-N+NO_3-N for the Silver Springs station) are due to the averaging of different sets of water quality data.

SOURCE: Kennedy/Jenks Engineers, April 1980.

Table H-8. Water Quality Standards, Lahontan Reservoir

Control Point	
Existing sample points	
Temperature °C	
Average (June through September)	Not more than 25
Summer Single Value	Not more than 30
Winter Single Value	Not more than 14
Maximum allowable temperature increase above natural receiving water temperature	Not more than 2
pH Units	
Annual Median	Within range 7.5-8.0
Single Value	Within range 6.5-8.5
Dissolved Oxygen - mg/l	
Average (June through September)	Not less than 6.5
Single Value	Not less than 5.5
BOD - mg/l	
Single Value	Not more than 2
Chlorides - mg/l	
Held for additional analysis	
Phosphates (PO_4) - mg/l	
Annual Average	Not more than 0.40 (0.13 as P)
Single Value	Not more than 0.60 (0.20 as P)
Nitrates (NO_3) - mg/l	
Single Value	Not more than 4.0 (0.90 as N)
Total Dissolved Solids - mg/l	
Pending further analysis	
Fecal Coliform -	The fecal coliform concentration, based on a minimum of 5 samples during any 30-day period, shall not exceed a geometric mean of 200 per 100 milliliters, nor shall more than 10% of total samples during any 30-day period exceed 400 per 100 milliliters.

SOURCE: Kennedy/Jenks Engineers, April 1980.

is DO. Mid-summer DO in the hypolimnion of the reservoir approaches the minimum adequate concentration (5 mg/l) required by trout. Lahontan Reservoir is presently inhabited by both rainbow and brown trout.

Based on concentration criteria (EPA, 1976) for classifying lakes and reservoirs as oligotrophic (nutrient poor), mesotrophic (moderately nutrient rich), and eutrophic (nutrient rich), 1976 concentrations of phosphate in Lahontan Reservoir place it in the eutrophic >.025 mg/l category. The most recent available concentration of orthophosphate (the biologically active form of phosphate) is 0.68 mg/l, measured in May 1976 from a bottom sample collected at Reno Narrows (Figure G-12).

The annual loading rate of total phosphorus (Total P) has been estimated (Vasey-Scott Engineering, 1978) to be 1.8-2.9 grams per square meter per year (gm/m^2/yr). This range is based on minimum and maximum possible retention times for phosphorus in the reservoir of 0.6 years and 1.0 years, respectively, and on USGS hydrographic and water quality data collected near the entrance of the Carson River to the reservoir from 1971 to 1976, USGS hydrographic data for the Truckee Canal near Hazen for 1966-1975, and USGS water quality data for the Truckee River near Nixon from 1974 to 1976. Tables H-9 and H-10 give some indication of the quality of inflowing water. The minimum retention time is calculated assuming that the Truckee Canal discharge short-circuits the reservoir and therefore does not contribute to reservoir nutrient enrichment. The maximum retention time is calculated assuming that the Truckee Canal discharge mixes completely with the water in the reservoir. The true loading rate lies somewhere between the two extremes. The annual supply of Total P which constitutes eutrophic conditions is 0.51-0.65 gm/m^2/yr (EPA, 1976).

Nitrate (NO_3-N) has been suggested as the limiting nutrient in Lahontan Reservoir (Vasey-Scott Engineering, 1978) and would appear to perhaps be so based on the EPA data. However, the NDW data show nitrate concentrations too high to be limiting. The most recent available concentration of NO_3-N in the reservoir recorded by NDW is 1.5 mg/l, from bottom samples collected at Reno Narrows and near the Lahontan Dam in May 1976.

TDS ranged from 183 mg/l (June 1967) to 108 mg/l (October 1975) from 1966 to 1976. Compared with Pyramid Lake, Lahontan Reservoir has about one-thirtieth the TDS concentration.

Table H-9. Carson River Water Quality, Near Fort Churchill (1)

Parameter	Units	Conc.	# of Samples
Total-P	mg/l	0.26	50
Total PO_4-P	mg/l	0.19	12
Ortho-P	mg/l	0.16	45
Total-N	mg/l	0.77	39
NH_3-N	mg/l	0.07	58
NO_3-N	mg/l	0.91	71
NO_2-N	mg/l	0.01	39
Organic-N	mg/l	0.40	59
Total Kjeldahl-N	mg/l	0.55	11
Zinc	mg/l	0.025	11
BOD_5	mg/l	1.0	1
TDS	mg/l	204	219

(1) Average of following data sources:

1. EPA, Region IX, "Water Quality Data, Truckee and Carson Rivers, Pyramid Lake and Lahontan Reservoir, a Working Paper", 1971 (Sampling Period 1966, 1978).
2. USGS, "Water Resources Data of Nevada", Water Years 10/64-9/77, except for Zinc (Water Years 10/75-9/77).
3. DRI, water quality data stored in computer, 7/72-3/75.

Apparent discrepancies in concentrations of certain constituents are due to the averaging of different sets of water quality data.

SOURCE: Kennedy/Jenks Engineers, April 1980.

Table H-10. Truckee Canal Water Quality

		Below Derby Dam - 9/68 (1)		At Fernley - 10/77 - 8/78 (2) 7/28/72 (3)		At Hazen - 7/28/72 (3)		Above Lahontan Dam - 7/72-3/75(3) 11/74-11/75 (4)		R/S JWPCP Effluent (5)
Parameter	Units	Conc.	# of Samples	Conc.	# of Samples	Conc.	# of Samples	Conc.	# of Samples	
Total-P	mg/l	0.73	1	0.91	6	-	-	0.23	14	0.4
Ortho-P	mg/l	0.64	1	0.73	7	0.71	1	0.25	32	-
Diss. Ortho-P	mg/l	-	-	-	-	-	-	0.16	13	-
Total-N	mg/l	-	-	3.84	6	-	-	-	-	21.5
NH_3-N	mg/l	0.37	1	0.57	6	-	-	0.08	14	16
NO_3-N	mg/l	0.62	1	1.7	7	0.66	1	0.45	32	1.0
NO_2-N	mg/l	-	-	0.11	6	-	-	-	-	1.5
NO_2-N plus NO_3-N	mg/l	-	-	-	-	-	-	0.23	14	-
Total Kjeldahl-N	mg/l	-	-	-	-	-	-	1.08	14	-
Organic-N	mg/l	0.31	1	1.4	6	-	-	-	-	-
BOD_5	mg/l	-	-	2.7	6	-	-	-	-	4
Zinc	mg/l	-	-	0.025	6	-	-	-	-	0.073
TDS	mg/l	145	1	193	7	228	1	160	32	324
pH	Unit	7.2-8.1	7	7.2-8.7	15	-	-	-	-	-
Temp.	°C	17-21	7	6-22	15	-	-	-	-	-

NOTES:

(1) EPA, Region IX, "Water Quality Data, Truckee and Carson Rivers, Pyramid Lake, and Lahontan Reservoir, A Working Paper", 1971.

(2) Pacific Environmental Laboratory, "Effects of the Reno/Sparks Joint Water Pollution Control Plant on Water Quality of the Truckee River", 1979.

(3) DRI, water quality data stored in computer, 7/72-3/75.

(4) EPA, water quality data stored in STORET computer data retrieval systm, 1974-75.

(5) R/S JWPCP effluent with PhoStrip treatment, and filtration.

Apparent discrepancies in concentrations of certain constituents are due to the averaging of different sets of water quality data.

SOURCE: Kennedy/Jenks Engineers, April 1980.

Fish

A warmwater fishery has developed as a result of prevailing warm temperatures and areas of shallow water. The fishery is supported primarily by white bass and white catfish. Lahontan Reservoir is the fourth ranked fishery in Nevada according to data compiled by the NDW (DOI, 1977).

The native fish species in the reservoir include the tui-chub (*Gila bicolor*), Tahoe sucker (*Catostomus tahoensis*), Lahontan redside (*Richardsonius egregius*), speckled dace (*Rhinichthys osculus*), and the Lahontan sucker (*Pantosteus lahontan*). Nonnative species include the rainbow trout (*Salmo gairdneri*), brown trout (*Salmo trutta*), largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieui*), white bass (*Morone chrysops*), white crappie (*Pomoxis annularis*), Sacramento perch (*Archoplites interruptus*), yellow perch (*Perca flavescens*), bluegull (*Lepomis macrochirus*), green sunfish (*Lepomis cyanellus*), white catfish (*Ictalurus catus*), channel catfish (*Ictalurus punctatus*), and bullhead (*Ictalurus* sp.). Nongame species include carp (*Cyprinus carpio*, Sacramento blackfish (*Orthodon microlepidotus*), and mosquitofish (*Gambusia affinis*).

Additional reviews of recent water quality investigations were done by Kennedy/Jenks Engineers (April 1980) and are quoted below.

> "The U. S. Geological Survey also sampled Lahontan Reservoir at numerous sites in the summer of 1979 (June and August), as part of its current Truckee River/Lahontan Reservoir water quality study. Analyses were conducted mainly on nutrients. The Nevada Department of Environmental Protection (NDEP) also conducted a water quality study of Lahontan Reservoir during the low flow conditions in late summer of 1979 (August-September). One to two samples were collected at each of four sites on the Reservoir during one day for analysis of nutrients, total dissolved solids, and other parameters. These results and the USGS results were not averaged with other data sources because they represented low flow, summer conditions, rather than annual averages. However, compared with the data averages shown in Table H-7, the Geological Survey generally detected lower nitrate concentrations and higher ammonia concentrations near the Reservoir bottom. The NDEP detected higher phosphate and kjeldahl nitrogen concentrations, and slightly higher ammonia and nitrate concentrations as compared to Table H-7 data. The TDS concentrations were not substantially different."

"USGS and NDEP data were observed for possible water quality trends. Each of the separate data sources which were averaged into the water quality table were also examined for possible trends. Although some of the data were conflicting, the results of the six studies appear to indicate that Lahontan Reservoir has slightly lower annual average total and orthophosphate concentrations towards the Carson River side compared to the Truckee Canal inflow area, with slightly greater concentrations during the summer season. Lahontan Reservoir also appears to contain slightly higher kjeldahl and organic nitrogen (except for the USGS finding in the summer of 1979) and slightly lower nitrate and nitrite concentrations towards the Carson River."

"Another water quality parameter of possible concern is mercury. Prior to 1900, gold and silver milling operations which utilized mercury in the extraction process were located along the Carson River. During 1971-72, a study of the mercury content in the waters and sediments of Lahontan Reservoir was conducted by the U. S. Geological Survey (Ref. 4). The study indicated that total mercury concentrations in Lahontan Reservoir were less than 1 g/l, and ranged from 0.2 g/l to 0.5 g/l. (The EPA interim limit for drinking water is 2 g/l). Bottom sediment concentrations increased in a down-river direction to Lahontan Reservoir, and ranged from 5.3 g/g to 20 g/g. In 1972, a survey was initiated by R. T. Richens and A. C. Risser, Jr. to study the mercury content in water, sediment and selected aquatic organisms in the Carson River drainage system (Ref. 5). Total mercury levels in white bass, white catfish, brown bullhead, and carp ranging in body wet weights of 120g to 540g were found to range from 0.211 ppm to 1.087 ppm. Mean total mercury content for the four species were, respectively, 1.297, 0.374, 0.544, and 0.743 ppm. The results indicate that mercury levels in some fish could exceed the 0.50 ppm maximum concentration considered by the Food and Drug Administration to be safe for human consumption."

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Reno-Sparks Joint Water Pollution Control Plant Master Project

Draft Environmental Impact Statement

Appendix I

Endangered Fishes and Wildlife Within The Project Area

June 1980

Prepared For:

U. S. Environmental Protection Agency
Region IX

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I-0

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ACRONYMS

BIA	U. S. Bureau of Indian Affairs
DO	Dissolved oxygen
DOI	U. S. Department of the Interior
EPA	U. S. Environmental Protection Agency
JWPCP	Reno-Sparks Joint Water Pollution Control Plant
PEL	Pacific Environmental Laboratory
PLITE	Pyramid Lake Indian Tribal Enterprise
USFWS	U. S. Fish and Wildlife Service

Appendix I

ENDANGERED FISHES AND WILDLIFE WITHIN THE PROJECT AREA

Introduction

The Endangered Species Act of 1973 was enacted by Congress to conserve endangered and threatened species and to provide a means whereby the ecosystems upon which endangered and threatened species depend may be conserved (PL 93-205). The term "endangered" species means any species which is in danger of extinction throughout all or a significant portion of its range other than a species or Class Insecta ... whose protection ... would present an overwhelming and overriding risk to man. The term "threatened" species means any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

In order to ensure the continued existence of an endangered or threatened species or their critical habitat, Section 7 of the Endangered Species Act requires federal agencies to consult with the U. S. Fish and Wildlife Service (USFWS) regarding actions they authorize, fund or carry out that could affect endangered or threatened species. Federal actions are to ensure the continued existence of endangered or threatened species are not to jeopardize or result in the adverse modification or destruction of their critical habitat.

The federal list of endangered and threatened species indicates that the endangered peregrine falcon (Falco peregrinus anatum), southern bald eagle (Haliaeetus leucocephalus leucocephalus), and cui-ui lakesucker (Chasmistes cujus), and the threatened Lahontan cutthroat trout (Salmo clarki henshawi) are found within the project area (Table I-1). The peregrine falcon has been observed in the Truckee Canyon area (Linsdale, 1936), however, its distribution is largely cosmopolitan. The peregrine falcon commonly nests on cliffs and feeds primarily on passerine birds, waterfowl and shorebirds. The southern bald eagle is known to winter throughout the area, primarily associated with lake and stream environments. Fish constitute the principal diet item. Among the endangered and threatened species in the project area two (cui-ui and Lahontan cutthroat trout) occupy habitat that could be affected by the Reno-Sparks JWPCP. Consequently, the following evaluations and discussions focus on these species.

Table I-1

ENDANGERED AND THREATENED SPECIES KNOWN
TO OCCUR IN THE STUDY AREA

Common Name	Scientific Name	Status
Southern bald eagle	Haliaeetus leucocephalus leucocephalus	Endangered
Peregrine falcon	Falco peregrinus anatum	Endangered
Lahontan cutthroat trout	Salmo clarki henshawi	Threatened
Cui-ui lakesucker	Chasmistes cujus	Endangered

SOURCE: USFWS, 1974.

Lahontan Cutthroat Trout, *Salmo clarki henshawi*

Current Status

Lahontan cutthroat trout, Salmo clarki henshawi, originally occurred throughout the Lahontan Basin in both the lacustrine and fluvial environments in Pyramid Lake, Walker Lake, Independence Lake, Lake Tahoe and Summit Lake, and in the Humboldt, Carson, and Truckee River systems. The native Lahontan Basin population is now largely extinct. The existing Truckee River cutthroat trout population is maintained through artificial propagation and stocking. Brood stocks from Independence Lake, California and Summit Lake, Nevada are the major sources of relatively pure strains of Lahontan cutthroat trout. The largest naturally reproducing population of Lahontan cutthroat trout is found in Summit Lake. Due to the success of the hatchery program and other stocking and management programs, the Lahontan cutthroat trout, originally listed as endangered, was reclassified to threatened status on July 16, 1975.

Reasons for the Decline of the Lahontan Cutthroat Trout

The construction of Derby Dam in 1905 and subsequent transbasin diversion of water for agricultural use in the Carson River Basin led to the decline of the native Pyramid Lake cutthroat trout population. Declining surface water level in Pyramid Lake resulted in the formation of a delta across the mouth of the Truckee River which greatly impeded upstream migration. Initially, the ramifications of dam construction and water diversion were not readily noticeable but by the late 1920s, the effects of water diversion had become more apparent. By 1939 there were 14 other unscreened diversions between Derby Dam and Nixon which contributed to lower flows, higher water temperatures, and lower dissolved oxygen (DO) concentrations (PEL, 1979). In addition, unscreened diversions turn many fish, especially juvenile fish, into canals and ditches where they die. Occasionally, the entire flow of the Truckee River had been either diverted or noticeably polluted. Waste from a paper mill at Floriston was regularly dumped in the river. As early as 1913, experimental hatchery studies showed this practice to be lethal to fishes. Sawdust was also being dumped in the river from nearby sawmills in the 1930s. A series of low water years which occurred during this time prevented the sawdust from being flushed from the river. Until about 1930, untreated sewage from the Cities of Reno and Sparks was also discharged to the river. This practice ended when the first sewage treatment plant was constructed. The combined effects of the transbasin diversion, unscreened diversions, and the degradation of the quality of water in the river were ultimately responsible for the extinction of the Pyramid Lake population of Lahontan cutthroat trout in the Truckee River. The last known spawning run occurred in 1938; however, instream flow and probably the quality of water was insufficient for reproductive success and thereafter the wild, naturally reproducing population became extinct.

Life History

Lahontan cutthroat trout are found in a variety of aquatic habitats including large alkaline lakes, small mountain lakes, major rivers and small tributaries (Moyle, 1976). Thus, it is assumed that their habitat requirements are broadly based and representative of trout in general. Observations by Snyder (1917) give a thorough account of two distinct cutthroat trout spawning migrations in the Truckee River system. The first migration involved the larger cutthroat trout variety known locally as "redfishes". Their migration generally ended in March. As the presence of the larger fish declined, the smaller variety ("tommies") entered the river. Although there was some overlap between the two migrations, fishes belonging to each spawning run were easily distinguishable.

In the absence of barriers, spawning cutthroat trout would leave Pyramid Lake beginning about the middle of February and generally spawn from April to early July. A study by Hansen (1979) to determine the effects of physical factors in the Truckee River on the spawning success of cutthroat trout indicates that the distribution of eggs in the river is dependent on the availability of suitable spawning grounds in the river. Table I-2 outlines the percentage of the river bed that is suitable spawning grounds from Lake Tahoe to Pyramid Lake. Once a suitable spawning site is located, the fertilized eggs are placed in the redd (nest) and covered by about 6 inches of gravel. The young hatch and emerge from the ground in about 6 to 8 weeks (McAfee, 1966). During their first year a few will migrate immediately down the river to the lake while others remain in the stream a year of more before migrating to the lake. Maturity is reached in 2 to 4 years in the lake.

Lahontan cutthroat trout feed primarily on invertebrates while small, but become piscivorous as they increase in size. Growth rate varies, depending on water temperature, abundance of food, and other factors.

Physical and Biological Factors Necessary to Restore Natural Population of Lahontan Cutthroat Trout

In order to assess the feasibility of reestablishing naturally reproducing populations of Lahontan cutthroat trout, the individual and related effects of temperature and flow and the concentrations of chemical constituents found in the Truckee River must be thoroughly evaluated in relation to habitat requirements.

Spawning of Lahontan cutthroat trout historically occurred in the river; however, the formation of the delta near the mouth of the Truckee River blocked the upstream migration of Lahontan cutthroat trout. This was a critical event because the Lahontan cutthroat trout are obligatory river spawners, requiring highly oxygenated, cold water and a gravel substrate in which to construct redds and deposit their eggs.

In 1975 the Marble Bluff Dam and Pyramid Lake Fishway began operation to restore access to the Truckee River for cui-ui and Lahontan cutthroat trout in Pyramid Lake. Studies conducted following the completion of these facilities showed that trout successfully ascended the fish ladder (USFWS, 1977). Since 1975 three Lahontan cutthroat trout spawning runs have ascended the fishway to the fish handling facility at Marble Bluff (Wolcott, 1978).

The Effects of Temperature and Flow on Lahontan Cutthroat Trout Survival

The Lahontan cutthroat trout is typical of coldwater species that require an environment in which temperature regimes do not exceed critical tolerance limits for spawning, egg incubation, and fry and fingerling development. Stream temperatures in the Truckee River are primarily dependent

Table I-2

PERCENTAGE OF SILT CONCENTRATIONS WITHIN AVAILABLE SPAWNING GROUNDS OF THE TRUCKEE RIVER FROM LAKE TAHOE TO PYRAMID LAKE

River Stretch	Length (Miles)	Silt concentration (% particles .833)	Spawning grounds (% of total)
Pyramid Lake to Derby Dam	33.84	20	5
Derby Dam to Vista	16.91	16	45
Vista to Reno	7.35	17	25
Reno to Farad	31.56	14	15
Farad to Lake Tahoe	30.34	12	10

SOURCE: Hansen, 1979.

Table I-3

PHYSICAL AND CHEMICAL STANDARDS NECESSARY FOR LAHONTAN CUTTHROAT TROUT SURVIVAL

	Criteria	Standard
Water Chemistry	pH	6.5-9.0[1]
	Alkalinity	>20 mg/l[1]
	DO	>5 mg/l or more[1]
	NH_3	<0.02 mg/l[1]
	As	Unknown
	Bi	Unknown
	Cl_2	<2 μg/l[1]
	Mn	1.0-15 mg/l[2]
	P	<50 μg/l[1]
	NO_3	≤2 mg/l[3]
	NO_2	0.03-0.06 mg/l[3]
Temperature	Upstream migration	<13.3°C[4]
	Spawning	<13.3°C[4]
	Egg incubation	10-13.3°C[4]
	Fry development	8.3-12.8°C[3]
	Maximum for adult survival	21°-23°C
Depth	Fry	.2-.4 feet[3]
	Juvenile	.2-1.0 feet[3]
	Adult	.8-1.8 feet[3]
	Spawning adult	.6-1 foot[3]
Velocity	Fry	>0.5 foot/second[3]
	Juvenile	>0.4 foot/second[3]
	Adult	>0.5 foot/second[3]
	Spawning adult	1.3-1.8 feet/second[3]

SOURCES:

[1] EPA, 1976
[2] Koch, pers. comm.
[3] Wolcott, pers. comm.
[4] DOI, 1977.

on instream flow. On-going temperature and water quality studies of the river below Derby Dam show that critical conditions to which trout are sensitive are often exceeded in this stretch of the river (USFWS, 1979). Other factors, such as the removal of riparian cover, power generation and municipal and agricultural diversions which reduce summer flows, also affect instream temperatures below Derby Dam (see Appendices E and F, SURFACE HYDROLOGY and SURFACE WATER QUALITY).

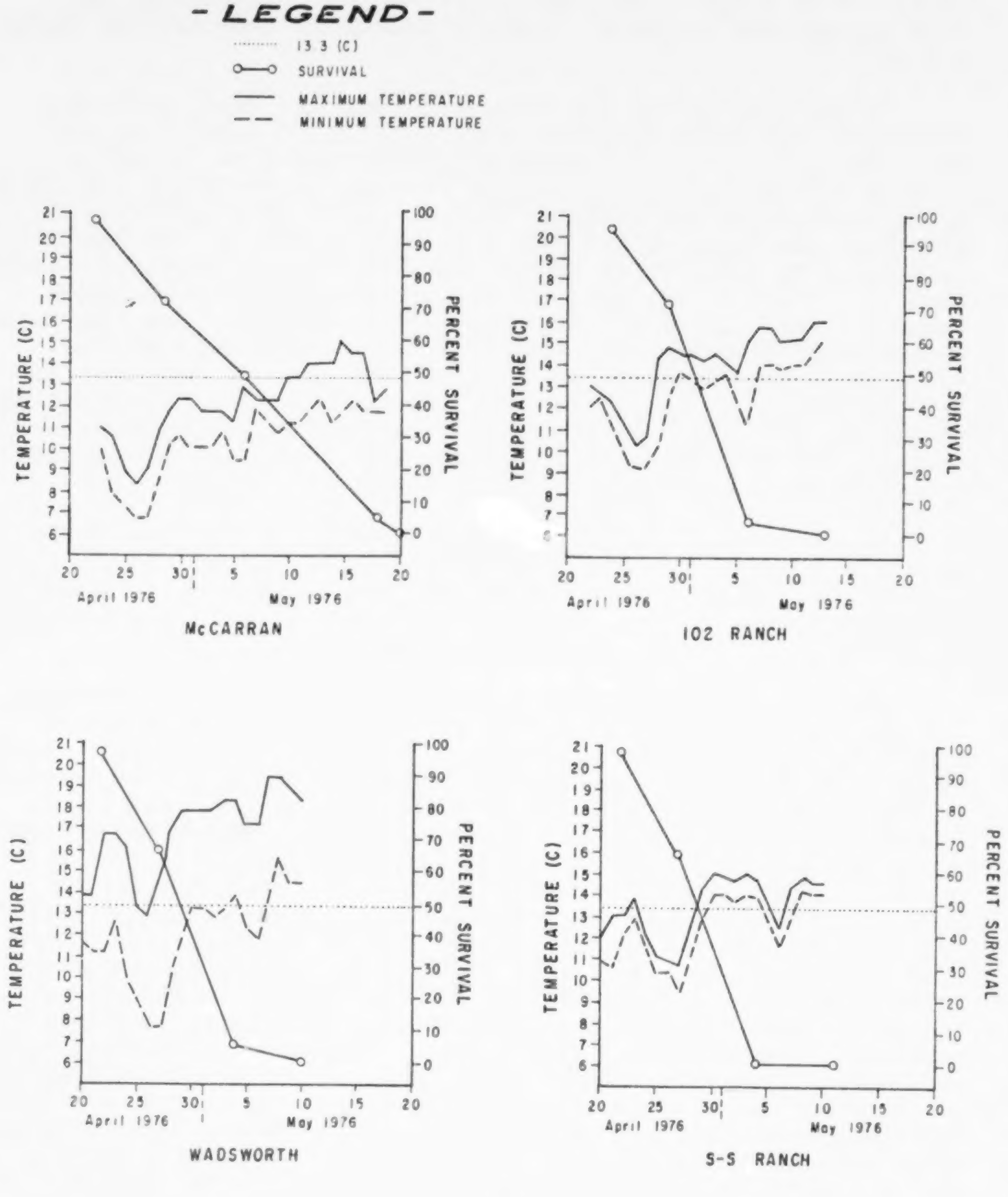
Trout habitat in the Truckee River has declined considerably since the initial construction of Derby Dam and subsequent inclusion of over 30 other diversion structures. Most of the major diversions of Truckee River water reported occur from April to October (Ringo, 1975) when cui-ui and Lahontan cutthroat trout are spawning. Five of the structures along the Truckee River divert water for hydroelectric generation on a year-round basis. The combination of the lower flows, warmer temperatures, poor water quality, and the actual presence of the dams eventually led to the demise of the adult spawning population. Present efforts to reestablish the cutthroat trout in the river have focused on eliminating barriers, abatement of pollution, and establishing flow and temperature requirements necessary for survival throughout the life stages of the cutthroat trout.

In addition, the U. S. Bureau of Indian Affairs (BIA) recently approved funds to develop the technical design for fencing the lower Truckee River from Wadsworth to Pyramid Lake and hopes to complete the construction of a portion of it by fall 1980 (Galat, pers. comm.).

Several factors which contribute to stress-induced egg and fry mortality are known to exist in the Truckee River. These factors include temperature, disease, siltation, invertebrate predation and exposure of redds during low flow periods (Hansen, 1979). In a study to evaluate the operation and passage of the Pyramid Lake Fishway daily maximum water temperatures in excess of 13.3°C (the maximum temperature for upstream migration and egg incuration) were recorded on 71 days in 1976 (from April 1 to June 27), 34 days in 1977 (from April 1 to June 2) (USFWS, 1979), and 30 days in 1978 (from April 1 to May 20) (Wolcott, 1978). In a preliminary study conducted during 1976 and 1977, USFWS (1979) attempted to correlate egg survival and temperature in artificial redds located above and below Derby Dam. The study indicated that mortality increases almost immediately when fertilized eggs are exposed to daily maximum temperatures in excess of 13.3°C. The sampling locations below Derby Dam showed a direct relationship between temperature and egg survival (Figure I-1). Environmental conditions above Derby Dam appeared to be most suitable at the Cal Van Gas Station (Figure I-2). Hatching success above Derby Dam ranged from about 80 percent at Cal Van Gas to only the survival of several fish to the alevin stage at the lowest sampling location above Derby Dam (Figure I-2).

Figure I-1

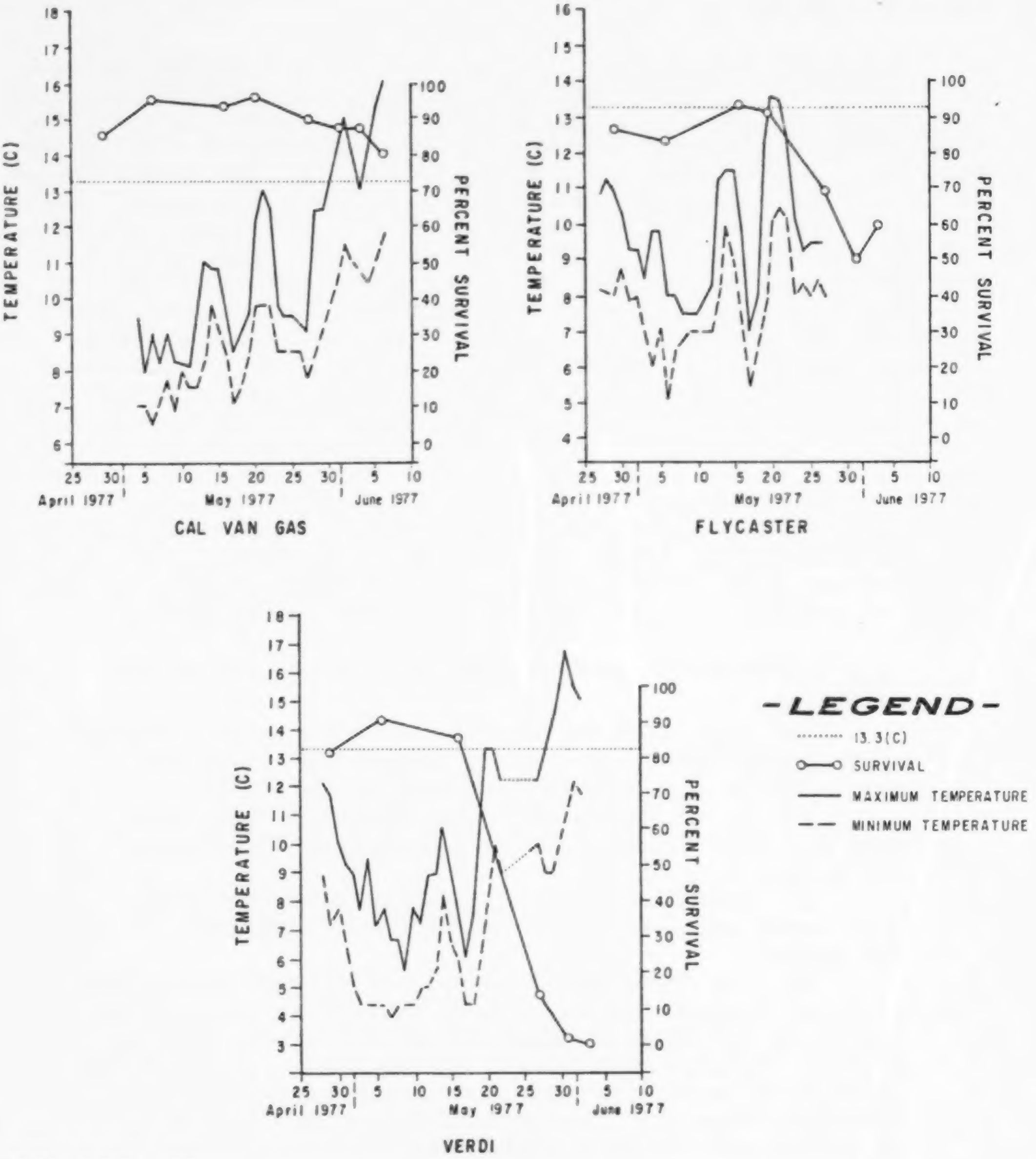
EGG SURVIVAL & DAILY MAXIMUM & MINIMUM TEMPERATURES AT FOUR ARTIFICIAL REDDS BELOW DERBY DAM IN 1977



SOURCE: USFWS, 1979

Figure I-2

EGG SURVIVAL & DAILY MAXIMUM & MINIMUM TEMPERATURES AT THREE ARTIFICIAL REDDS LOCATED ABOVE DERBY DAM IN 1977



SOURCE: USFWS, 1979

The quantity of flow released from upstream storage areas is important as a temperature regulator in the river below Derby Dam. Instream temperatures above 13.3°C (DOI, 1977) and dissolved oxygen concentrations less than 5 mg/l (EPA, 1976) have been shown to limit the survival of fishes in the Truckee River below Derby Dam. The temperature tolerance limits may vary depending on the stage of development of the trout (Table I-3).

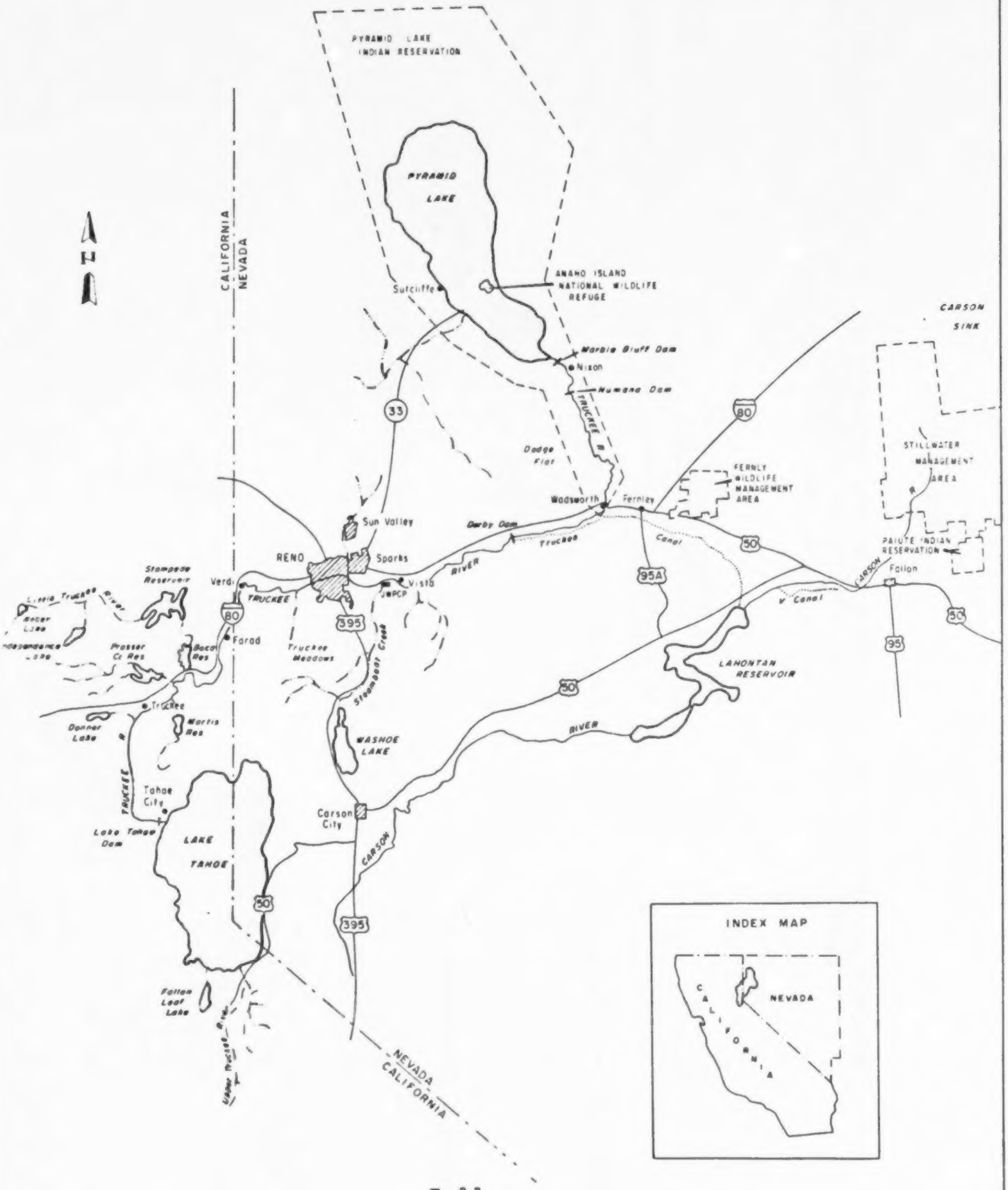
Several methods have been used to establish minimum flow and temperature tolerance limits for trout in the Truckee. Some involve elaborate modeling systems (USFWS, 1979; Rowell, 1975; Hansen, 1979) while others rely on scientific judgment (Sigler, 1976).

Sigler's Testimony. In the case of the United States of America and Pyramid Lake Paiute Tribe of Indians v. Truckee-Carson Irrigation District, et al. (Case Number R-2987-JBA, Reno Federal District Court), Dr. William Sigler (1976) testified that conditions now present in the Truckee River below Derby Dam make it unacceptable as a coldwater stream. He attributes the existing condition of the river to channelization and vegetation removal by the U. S. Army Corps of Engineers, which resulted in unstable streambanks, silted spawning areas, high water temperatures, and destruction of cover for young fish. Sigler testified that although the stretch of river from Vista to Derby Dam is suitable for natural reproduction the best area for natural spawning is between Farad and Vista (Figure I-3). Further testimony by Sigler included his recommendations for acceptable flow regimes for trout. By inference, these regimes would also be acceptable for cui-ui since it is believed that they can survive higher temperatures than trout. Table I-4 depicts minimum acceptable flows for spawning, hatching, and habitat maintenance from Farad to Derby Dam, and Table I-5 defines flows necessary for fish transport below Derby Dam.

> In discussing these recommended flows, Sigler testified that:
>
> "(a) The period for spawning and hatching is from March-April through June, and that the temperature requirement for the adult fish should be the same as for the eggs.
>
> (b) It is assumed that after the young fish hatch, they will stay in the river for a minimum of 6 months and for as long as 2 years.
>
> (c) The young fish will probably start to migrate back toward the lake at the first flush of high water in the spring.
>
> (d) The recommended volumes of flow under the columns entitled 'minimum acceptable' and 'desirable' represent his opinion of the range of general flows required so that the fish can reproduce successfully in the river, and successful spawning is possible between those minimum acceptable and desirable flows, but the degree of success would probably be greater when you were closer to the desirable flows.

Figure I-3

REGIONAL AREA



N
PYRAMID LAKE INDIAN RESERVATION
PYRAMID LAKE
CALIFORNIA
NEVADA
ANAHO ISLAND NATIONAL WILDLIFE REFUGE
Sutcliffe
CARSON SINK
Marble Bluff Dam
Nixon
Numana Dam
TRUCKEE R
33
80
Dodge Flat
STILLWATER MANAGEMENT AREA
FERNLY WILDLIFE MANAGEMENT AREA
Wadsworth
Fernley
Sun Valley
Derby Dam
Truckee
Canal
50
PAIUTE INDIAN RESERVATION
RENO
Sparks
RIVER
CARSON
Fallon
Stampede Reservoir
Verdi
Vista
JWPCP
95A
V Canal
Little Truckee River
Boca Res
TRUCKEE
395
Independence Lake
Prosser Cr Res
Farad
Truckee Meadows
Steamboat Creek
95
LAHONTAN RESERVOIR
Truckee
Donner Lake
Martis Res
WASHOE LAKE
RIVER
Tahoe City
Lake Tahoe Dam
Carson City
LAKE TAHOE
CARSON
Fallen Leaf Lake
Upper Truckee River
NEVADA
CALIFORNIA
INDEX MAP
CALIFORNIA
NEVADA

Table I-4

MINIMUM ACCEPTABLE AND DESIRABLE FLOW RECOMMENDATIONS FOR LAHONTAN CUTTHROAT TROUT SPAWNING, HATCHING AND HABITAT MAINTENANCE IN THE TRUCKEE RIVER FROM FARAD TO VISTA AND VISTA TO DERBY DAM

	FARAD - VISTA				VISTA - DERBY			
	MINIMUM ACCEPTABLE		DESIRABLE		MINIMUM ACCEPTABLE		DESIRABLE	
Spawning Hatchery Flow	cfs	Acre Feet	cfs	Acre Feet	cfs	Acre Feet	cfs	Acre Feet
April	300	(17,851)	400	(23,802)	500	(29,752)	850	(50,579)
May	600	(36,893)	800	(49,190)	700	(43,042)	1,000	(61,488)
June	600	(35,703)	750	(44,628)	700	(41,653)	1,100	(65,455)
Habitat Maintenance								
July	500	(30,744)	600	(36,893)	600	(36,893)	850	(52,265)
August	450	(27,699)	600	(36,893)	400	(24,595)	800	(49,190)
September	350	(20,826)	500	(29,752)	300	(17,851)	600	(35,703)
Habitat Maintenance & Young transportation								
October	300	(18,446)	400	(24,595)	300	(18,446)	500	(30,744)
November	300	(17,851)	400	(23,802)	300	(17,851)	400	(23,802)
December	250	(15,372)	300	(18,446)	300	(18,446)	400	(24,595)
January	250	(15,372)	300	(18,446)	300	(18,446)	400	(24,595)
February	250	(13,884)	300	(16,661)	300	(16,661)	400	(22,215)
March	400	(24,595)	500	(30,744)	400	(24,595)	650	(39,967)
		275,206		353,852		308,231		480,598

SOURCE: Sigler, 1976.

Table I-5

ABSOLUTE MINIMUM ACCEPTABLE FLOWS FOR FISH TRANSPORT BELOW DERBY DAM

BELOW DERBY

	Disaster		Absolute Minimum For Movement		Desirable	
	cfs	Acre Feet	cfs	Acre Feet	cfs	Acre-Feet
April	50	(2,975)	300	(17,851)	450	(26,777)
May	50	(2,975)	450	(27,670)	600	(36,893)
June	50	(2,975)	300	(17,851)	450	(26,777)
July	50	(2,975)	75	(4,611)	200	(12,297)
August	50	(2,975)	75	(4,611)	200	(12,297)
September	50	(2,975)	75	(4,463)	200	(11,901)
October	50	(2,975)	75	(4,611)	300	(18,446)
November	50	(2,975)	75	(4,463)	200	(11,901)
December	50	(2,975)	75	(4,611)	200	(12,297)
January	50	(2,975)	75	(4,611)	200	(12,297)
February	50	(2,975)	75	(4,165)	200	(11,107)
March	50	(2,975)	100	(6,148)	300	(18,446)
				105,666		211,436

SOURCE: Sigler, 1976.

(e) Basically, the desirable flows are what he believes are best for the river and the minimum acceptable flows would be acceptable in the event of below normal water years or in the event of other demands for the water.

(f) His recommended minimum acceptable and desirable flows meet the temperature requirements for the fish reproduction.

(g) His recommended flows assume no natural reproduction of cutthroat trout in the river below Derby Dam and his recommended flows for the river below Derby are just transportation flows.

(h) The flows for the area below Derby Dam in the column entitled 'Absolute Minimum for Movement' and 'Desirable' are suitable for the fish transportation.

(i) These recommended flows will have to be looked at and refined as their studies progress but it is his firm opinion that they will not vary more than 10 percent (plus or minus) from these recommended flows."

Testimony of William Sigler in United States of America and Pyramid Lake Paiute Tribe of Indians v. Truckee-Carson Irrigation District, et al. (Case Number R-2987-JBA, Reno Federal District Court), as summarized by Frederick Girard, Attorney at Law, Sacramento, California.

Rowell's Model. Rowell's (1975) model estimates minimum flows required to maintain suitable temperature control for spawning, egg incubation, holding, and migration of cutthroat trout in the Truckee River. This model examines the effects of varying flows on the daily temperature regimes in the river. The stream temperature model is based on an exponential temperature decay equation developed by Edinger and Geyer:

$$TF = (TI - EA)\ e^{\alpha} + EA$$

Where TF = temperature at the downstream end of a river reach in °F; TI = the temperature at the upstream end of the reach in °F; EA = the average equilibrium temperature in °F over the time and distance that the river flows from the beginning to the end of the reach; and

$\alpha = -(KA \times W \times RL)/(C1 \times Cp \times Q)$

Where KA = the average heat exchange coefficient over the time and distance that the river flows from the beginning to the end of the reach in BTU/feet^2. - °F - Day, W = the average width of the river reach in feet, RL = the length of the reach in feet, C1 = the density of water in pounds per feet^3, Cp = the specific heat of water = 1 BTU/pound-°F, and Q = the average flow over the reach in feet^3/day.

Tables I-6 and I-7 present the resultant flows and supplemental releases predicted by the model required to maintain specified temperature limits for Lahontan cutthroat trout in the Truckee River below Derby Dam. The model assumes upper temperature tolerance limits of 13.3-13.8°C for spawning and incubation, 21.1°C for holding and migration, and 25°C for survival.

Table I-6

PREDICTED LOWER TRUCKEE RIVER FLOWS REQUIRED FOR TEMPERATURE CONTROL (ft^3/S)

Month	River Temperature Limits For Fish[1/] °F	Historical Truckee Canal Diversions[2/] Temperature Condition[3/]				Low Truckee Canal Diversions[2/] Temperature Condition[3/]			
		Low	Normal	High	Record Highest	Low	Normal	High	Record Highest
March	56	0	10	40	530	0	17	56	610
	57	0	0	30	440	0	12	42	520
April	56	32	330	450	1,860	48	390	500	1,970
	57	21	250	350	1,600	32	300	400	1,700
May	57	380	1,000	1,260	3,200	460	1,100	1,350	3,200
	65	30	160	260	1,000	52	220	310	1,100
June	57	>4,000	>4,000	>4,000	>4,000	>4,000	>4,000	>4,000	>4,000
	70	160	260	440	1,700	200	320	500	1,700
July	70	640	1,100	1,500	2,340	680	1,100	1,500	2,340
	77	110	250	390	810	130	280	420	860
August	70	380	700	1,500	2,250	420	750	1,520	2,330
	77	33	105	320	640	46	120	360	700
September	70	15	76	180	610	22	90	200	680
October	70	0	0	0	76	0	0	0	106

1/ 56/57°F - Spawning and Incubation ; 65°F - Intermediate Temperature
70°F - Holding and Migration
77°F - Survival

2/ Historical Diversions - Avg. of 1965-74 Records (10)
Low Diversions - Based on USBR Operation Study (8)

3/ Low - Lowest mean monthly air temp. in 30 years (1941-70)
Normal - Average mean monthly air temp. in 30 years (1941-70)
High - Highest mean monthly air temp. in 30 years (1941-70)
Record Highest - Highest maximum daily air temp. in 30 years (1941-70)

SOURCE: Rowell, 1975.

Table I-7

UPPER TRUCKEE RIVER FLOWS AND SUPPLEMENTAL RELEASES FROM STAMPEDE REQUIRED FOR TEMPERATURE CONTROL IN THE LOWER TRUCKEE RIVER

(NORMAL AIR TEMPERATURES ASSUMED)

Month	River Temperature Limits For Fish °F	Required Floriston Flow Ft^3/S		Required Supplemental Releases from Stampede			
		Historical T.C. Diversions	Low T.C. Diversions	Historical T.C. Diversions		Low T.C. Diversions	
				Ft^3/S	Acre-Feet	Ft^3/S	Acre-Feet
March	56	70	0	0	0	0	0
	57	60	0	0	0	0	0
April	56	700	440	200	11,900	0	0
	57	620	350	120	7,100	0	0
May	57	1,540	1,230	1,040	63,900	730	44,900
	65	700	350	200	12,300	0	0
June	57	> 4,000	> 4,000	> 4,000	> 238,000	> 4,000	> 238,000
	70	830	540	330	19,600	40	2,400
July	70	1,610	1,420	1,110	68,300	920	56,600
	77	760	500	260	16,000	0	0
August	70	1,170	1,060	670	41,200	560	34,400
	77	575	430	75	4,600	0	0
September	70	526	300	26	1,500	0	0
October	70	410	200	0	0	0	0

SOURCE: Rowell, 1975.

Hansen's Model. The mathematical model utilized by Hansen (1979) focuses on several physical characteristics of the Truckee River which may influence trout survival. This model incorporates the suggestions and comments of USFWS and the consulting firm of W. F. Sigler and Associates, Inc. The objective of the model was to predict survival of trout which enter the river as unfertilized eggs and leave as fingerlings. Table I-8 shows the rate of mortality of unfertilized eggs, fertilized eggs, yolk sac fry, emerging fry, and fingerlings in the Truckee River. Table I-9 shows the river flow rates and temperatures used for the standard run, and the flow rates and temperatures used to simulate low flow-high temperature regimes are contained in Table I-10.

Probability-of-Use Curves. Probability-of-use curves have been developed by the USFWS (1979) for cutthroat trout in the Truckee River. These criteria are used to assess the impacts of altered stream flow on the Truckee River stream habitat.

> "Probability-of-use curves are developed from those habitat parameters related to stream hydraulics: depth, velocity, substrate, and temperature. The inherent assumption of these curves is that individuals of a species will tend to select areas within the stream having the most favorable combinations of hydraulic conditions. These individuals will also utilize less favorable conditions, however, the probability-of-use decreases as one or more of the hydraulic conditions becomes less favorable. Lastly, it is assumed that individuals will voluntarily leave a less favored area before conditions become lethal" (USFWS, 1979).

Present Efforts to Restore a Reproductive Population of Lahontan Cutthroat Trout

The USFWS (1979) recommended measures needed to restore a reproductive population of Lahontan cutthroat trout to the Pyramid Lake/Truckee River system, including:

- Restoration of the lower river riparian corridor from Wadsworth to reduce water temperature. Suggestions for its restoration include:

    a. Fencing the lower river from Wadsworth to Pyramid Lake to prevent cattle grazing and trampling. (The BIA recently approved funds for the design of fencing the lower river from Wadsworth to Pyramid Lake (Galat, pers. comm.).

Table I-8

RATE OF MORTALITY OF UNFERTILIZED EGGS, FERTILIZED EGGS, YOLK SAC FRY, EMERGING FRY AND FINGERLINGS IN THE TRUCKEE RIVER

	Run 1 Standard run	Run 2 Diversion mort. potential set to .5 for all diversions	Run 3 Derby Dam flow set to 50 cfs for the months June - August	Run 4 Fishing surv. set at .700	Run 5 Temperature and flow regime	Run 6 April temp. stretch one raised from 41 to 43 F
Unfertilized Egg						
Number surviving	6,029,980	6,029,980	6,029,980	4,765,945	1,084,084	278,159
Surv. through stage	.060	.060	.060	.047	.011	.0028
Surv. within stage	.060	.060	.060	.047	.011	.0028
Egg						
Number surviving	2,006,419	2,006,419	2,006,419	1,577,453	155,781	58,942
Surv. through stage	.020	.020	.020	.016	.0016	.00059
Surv. within stage	.332	.332	.332	.332	.114	.212
Yolk Sac Fry						
Number surviving	897,137	897,137	897,137	704,006	56,901	20,426
Surv. through stage	.0090	.0090	.0090	.0070	.00057	.00020
Surv. within stage	.447	.447	.447	.447	.365	.346
Emerging Fry						
Number surviving	430,580	430,580	430,580	337,204	26,053	9,761
Surv. through stage	.0043	.0043	.0043	.0034	.00026	.000097
Surv. within stage	.479	.479	.479	.479	.458	.478
Fingerling						
Number surviving	15,047	124,393	75,358	13,327	15	440
Surv. through stage	.00015	.00124	.00075	.00013	.00000015	.0000044
Surv. within stage	.0349	.289	.175	.0349	.000576	.045

SOURCE: Hansen, 1979.

Table I-9

RIVER FLOW RATES AND TEMPERATURES USED FOR THE STANDARD RUN

FLOW-CFS

STRETCH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	813	928	1960	1779	855	591	415	456	654	1043	587	730
2	814	940	1990	1866	950	711	543	562	725	1093	624	737
3	746	879	1947	1841	904	676	559	536	650	1022	652	636
4	667	815	1888	1826	968	930	646	641	685	1018	532	539
5	394	319	179	1427	735	380	464	429	454	369	544	443

TEMPERATURE-(F)

STRETCH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SET	OCT	NOV	DEC
1	33	33	37	41	47	55	61	61	51	43	37	33
2	33	33	37	43	45	55	61	61	51	43	37	33
3	33	33	37	43	47	55	59	61	53	43	39	33
4	33	33	37	41	45	53	59	59	51	45	37	33
5	33	33	37	41	43	53	57	57	51	45	39	33

SOURCE: Hansen, 1979.

Table I-10

RIVER FLOW RATES AND TEMPERATURES USED TO SIMULATE LOW FLOW - HIGH TEMPERATURE REGIME

FLOW-CFS

STRETCH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	402	415	432	257	259	75	82	118	170	245	354	299
2	603	620	645	500	490	340	313	347	375	461	570	505
3	532	542	607	515	445	332	294	316	318	380	580	476
4	460	460	558	503	461	405	400	403	404	370	442	450
5	203	301	395	392	369	381	410	409	394	289	299	300

TEMPERATURE-(F)

STRETCH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	37	39	41	50	62	71	74	76	69	64	48	37
2	35	37	41	50	62	67	69	70	66	61	45	39
3	35	37	39	49	61	66	67	69	65	58	47	41
4	33	36	39	48	59	65	66	66	62	58	45	39
5	33	35	39	48	57	60	62	65	60	57	45	41

SOURCE: Hansen, 1979.

   b. Expedite revegetation by strategically planting native riparian trees.
   c. Provide bank stabilization in the form of gabions or rip-rap along highly erodible banks.
   d. Protect trees from beaver damage.
   e. Employ Rowell's (1975) temperature prediction model for the lower Truckee River to ensure cool summer water temperatures.

- Screening or consolidation of open diversions.

- Installing ladders or modifying existing ladders for Derby Dam and the four power diversions in the upper river (Washoe, Fleish, Verdi and Farad) to permit adult cutthroat access to the entire main stem of the Truckee River and its tributaries.

- Spawning habitat in the main stem of the Truckee River is limited. Measures to increase or improve spawning habitat include:

   a. Utilization of and production from existing spawning habitat should be maximized.
   b. Flows that provide the maximum possible spawning habitat should be sought.
   c. Feasibility of mechanically cleaning gravel beds should be investigated.
   d. Silt in the river should be reduced by restoring riparian vegetation to reduce bank erosion and curtail the sluicing of Derby Dam.

Cui-ui Lakesucker, *Chasmistes cujus*

Current Status

The cui-ui is an endangered lacustrine sucker which primarily inhabits the deep waters of Pyramid Lake but congregates at the mouth of the Truckee River during the spring to spawn. Historically, the cui-ui fishery was very important in the culture and diet of the Paiute Indians; however, they are now faced with extinction due to the inaccessibility of ancestral spawning grounds. The cui-ui was originally listed as endangered in the Federal Register, March 11, 1967. Critical habitat for the cui-ui has not been determined, although a recovery plan has been prepared for this species.

Reasons for the Decline of the Cui-ui

The Pyramid Lake cui-ui population has been on the decline since the construction of Derby Dam and the establishment of the Newlands Reclamation Project in 1905. The operation of Derby Dam diverts water necessary for transporting cui-ui to spawning habitat in the Truckee River. In addition, the construction of Numana Dam on the Pyramid Lake Indian Reservation in 1917 limited spawner access to the lower 20.3 km (12.7 miles) of the Truckee River. Since the inception of the many diversion projects on the river the level of Pyramid Lake has declined and subsequently formed a silt delta across the mouth of the Truckee River, virtually eliminating the upstream spawning migration of cui-ui. Cut off from their ancestral spawning grounds, they are forced to spawn in the shallow shoreline areas where freshwater inlets enter the lake (Figure I-3). The productivity of the species has been lowered to the point where it is now endangered.

Life History

The cui-ui (*Chasmistes cujus*) is an indigenous lacustrine sucker found only in Pyramid Lake, Nevada. Relict populations of the genus *Chasmistes* occur in Klamath Lake (*C. brevirostris*) and Utah Lake (*C. liorus*). All three species are believed to have originated from a common ancestor in the ancient Lahontan system. Since its original description by Cope (1883) very little scientific data have been collected on the cui-ui life history. Snyder (1917) provided the original description of the spawning habits of cui-ui in the Truckee River. Since that time, the construction of over 30 diversions on the Truckee River has restricted cui-ui spawning to Pyramid Lake. Until recently, little new information has been added to Snyder's original description.

Generally, cui-ui are observed only during the spawning season. At other times, they are believed to inhabit the deeper waters of Pyramid Lake. Spawning takes place in shallow waters near the mouth of tributaries beginning during the middle of March and peaking in mid-May. Historically, cui-ui ascended the Truckee River to spawn. Now, all cui-ui spawning takes place in the lake. Koch (1973) observed cui-ui spawning activity on the east side of Pyramid Lake in the Hell's Kitchen area. The success rate of cui-ui egg hatching is low. This may be attributed to the lack of adequate spawning sites, predation of fertilized eggs by the tui chub or egg decomposition resulting from a fungus of the genus *Saprolegnia*. In light of these adverse conditions, Koch (1973) postulates that the spawning success of cui-ui in Pyramid Lake is less than 1 percent.

Concomitantly, few studies have been conducted to analyze the food preference of cui-ui. Johnson (1958) examined the stomach contents of cui-ui sampled from Pyramid Lake. His findings show zooplankters as the main food item in the cui-ui diet. Stomach analyses performed by Koch (1976) indicated a preference for Miona in the earlier feeding stages of cui-ui.

Present Efforts to Reestablish Cui-ui Spawning Access in the Truckee River

The loss of spawning access in the Truckee River spearheaded a number of measures to restore the cui-ui fishery. Initial studies entailed the compilation of baseline data such as age and growth, population estimates and sex composition. Subsequent studies concentrated on the development of artificial propagation techniques, stocking programs, barrier removal and population monitoring. Monitoring of the cui-ui spawning population has occurred since 1971 (Sonnevil, 1977). In 1975, USFWS started an on-going program to restore the endangered cui-ui through implementation of the Cui-ui Recovery Plan (USFWS, 1977). The draft plan was completed in 1977 and critical habitat information contained in the plan is presently awaiting publication in the Federal Register.

Artificial Propagation. The major cui-ui restoration effort has been the development of an artificial propagation technique. This technique was developed by Koch (1972) to artificially propagate cui-ui in an experimental hatchery on Hardscrabble Creek within the Pyramid Lake Basin. The procedure involves stripping egg and sperm from adult cui-ui and placing the fertilized material into hatching jars. Since 1973, 7.8 million larval fish have been stocked in Pyramid Lake and the Truckee River. The total egg take during the 1978 spawning season was approximately 2.1 million eggs (Sonnevil, 1978). Unfortunately, problems with personnel and equipment reduced production to approximately 168,000 larval fish. Of this total, 160,000 fishes were stocked in the river and 8,000 were held for release as yearlings in the spring of 1979.

The Pyramid Lake Indian Tribal Enterprise (PLITE) is also actively involved in the management and restoration of the fishery. The presence of iron bacteria in the hatchery well water and upstream diversions of Hardscrabble Creek water necessitated moving the existing facilities. Through a cooperative agreement with USFWS and PLITE, the cui-ui facilities were moved to the PLITE existing cutthroat trout facilities (Dunn Fish Hatchery) (Sonnevil, 1978). Other tribal programs which augment the restoration of the cui-ui and the Lahontan cutthroat trout include a creel census program and enforcement of sport fishing regulations.

Pyramid Lake Fishway. The purpose of the Pyramid Lake Fishway was to remove the upstream barrier posed by the river delta and restore river access for the Lahontan cutthroat trout and cui-ui. However, the present fishway design proved inadequate for the cui-ui. No cui-ui migrated through the fishway in either 1976 or 1977. Based on studies conducted in both years and the report by Koch and Contreras (1972) which confirms the poor swimming and jumping ability of adult cui-ui, it was determined that turbulence and/or velocity within the fishway was inhibiting their movement. In 1978, a modified fish ladder which doubled the number of pools in the ladder resulted in limited success. These studies will continue to determine if existing facilities can be adequately modified for cui-ui passage.

Population Monitoring. A systematic sampling program was initiated in 1977 to monitor the adult spawning population and assess the success of the propagation program (Sonnevil, 1978). However, no data on natural propagation are available. This sampling program was continued in 1978. In addition, a detailed age and growth study was conducted with the 1978 spawning population. The age of fish was determined by scale analysis. Relative year class strength was determined by the percentage each group contributed to the sample total. Comparisons of 1977 catch per unit of effort (c/f) values to data from previous years showed a significant decrease in the spawning population. Reasons for the decline remain unknown. A large number of small fish were present in the 1977 sampling program. Their presence was encouraging since sampling programs in prior years showed no similar quantities of small fish. The presence of these smaller fishes is believed to represent recent recruitment to the sampling population.

Cui-ui Recovery Plan Outline

Prime Objective: To restore the Cui-ui to non-endangered status; to reclassify from endangered to threatened.

1. To maintain a self-sustaining population at optimum level in Pyramid Lake.
    11. To protect Cui-ui population.
        111. To develop interagency cooperation to protect cui-ui populations.
            1111. Protect population of stream spawning cui-ui in Truckee River.
            1112. Protect all age-class cui-ui in Pyramid Lake to insure optimum breeding stock.
        112. To assess predator depredation.
            1121. Determine predation on juvenile cui-ui by other fish: i.e. Sacramento perch and Lake chub.
            1122. Determine predation on cui-ui eggs by other fish.
            1123. Determine predation on all age cui-ui by birds: i.e. pelicans, herons, etc.
        113. To act on predation findings in #112.
    12. To restore and maintain essential habitat in Pyramid Lake and inflowing streams.
        121. To conduct life history studies for application in protecting cui-ui habitat.
            1211. Study chemical, biological, and physical factors affecting cui-ui.
            1212. Conduct age and growth studies of various life stages.
            1213. Study and characterize reproductive cycle of cui-ui.
            1214. Assess population including natural reproduction.
            1215. Conduct behavioral studies.

122. To restore and maintain Truckee River access and egress for cui-ui.

  1221. To maintain and operate fishways if needed.

    12211. Design, construct and modify fishways if needed.
    12212. Determine needs for fishways.
    12213. Operate Marble Bluff Fishway.
    12214. Maintain Numana Dam Fishway and ladder.

  1222. To maintain and operate diversion screens if needed.

    12221. Design and construct diversion screens if needed.
    12222. Determine needs for diversion screens.
    12223. Operate and maintain screens at Numana Dam.

123. To restore and maintain Truckee River habitat.

  1231. To determine how to restore river habitat.

    12311. Determine optimum habitat requirements for cui-ui needed to maintain and restore habitat conditions.
    12312. Determine existing habitat conditions.
    12313. Conduct literature review and compilation.

  1232. To take action to maintain or restore optimum habitat conditions identified in #1231 and as needed.

    12321. Control animal damage to stream bank soils and vegetation.
    12322. Regulate stream channelization efforts.
    12323. Enforce water pollution regulations.
    12324. Establish and maintain optimum flow for spawning and habitat protection.
    12325. Remove as many barriers to fish passage as possible.
    12326. Restore stream canopy.
    12327. Periodically remove trash and renovate stream.
    12328. Reduce competing "rough" fish populations and predation to eggs.

124. To maintain suitable Pyramid Lake habitat and initiate actions needed for optimum conditions.

  1241. To determine how to obtain lake habitat for cui-ui.

    12411. Determine optimum lake habitat requirements for cui-ui.
    12412. Determine existing lake conditions.
    12413. Conduct literature review and compilation on Pyramid and similar lake habitats, including

effects of total dissolved solids.
12414. Determine the effects of total dissolved solids on egg development.
12415. Determine effect of total dissolved solids on lake limnology.
12416. Determine quality and quantity of inflow and other factors needed to maintain optimum lake habitat conditions.
12417. Determine effects of total dissolved solids on juvenile development.

1242. To conduct actions to maintain or restore optimum habitat conditions as identified in #1241 and as needed.

13. To determine critical habitat as designated under the 1973 Endangered Species Act.

14. To augment population with hatchery-reared cui-ui until natural reproduction is established.

141. To assess survival of hatchery-reared cui-ui in Pyramid Lake.

142. To construct, operate, and maintain spawning channels, nursery ponds and hatchery facilities; produce two million fry annually.

1421. Design and construct hatchery, nursery ponds, spawning channels, etc.

1422. Develop hatchery-rearing techniques.

14221. Develop juvenile-rearing techniques.
14222. Develop broodstock-rearing techniques.

1423. Train tribal members in fish cultural techniques.

1424. Operate hatchery and improve existing fish cultural facilities.

14241. Enlarge existing facilities as needed.
14242. Operative hatchery facilities.
14243. Improve and protect the Hardscrabble hatchery water supply.

142431. Acquire Peigh ranch.
142432. Take other stream protective actions as required.

1425. Obtain adult cui-ui for artificial propagation.

143. To release a minimum of two million hatchery-reared cui-ui into Pyramid Lake annually.

2. To establish viable subpopulations at other suitable sites if needed.
    21. To select suitable sites.
        211. Evaluate various habitats.
        212. Select suitable habitats; interrelate with #121.
        213. Obtain necessary approval for transplants.
    22. To obtain transplant seed stocks.
    23. To make transplants.
    24. To monitor transplants.
3. To educate the public on the Cui-ui recovery effort.
    31. Develop informational leaflets and distribute.
    32. Provide current information to the news media on progress of Cui-ui restoration program.

SOURCE: USFWS, 1977.

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Reno-Sparks Joint Water Pollution Control Plant Master Project

Draft Environmental Impact Statement

Appendix J

Fish and Wildlife Resources

June 1980

Prepared For:

U. S. Environmental Protection Agency
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J-0

Report Preparation

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J-0a

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Acronyms

cfs	cubic feet per second
JWPCP	Reno-Sparks Joint Water Pollution Control Plant
NDW	Nevada Department of Wildlife
TCID	Truckee-Carson Irrigation District
TL	Total Length
USFWS	U. S. Fish and Wildlife Service

J-0d

FISH AND WILDLIFE RESOURCES

Fishes in the Truckee River

Fishes in the Truckee River system from Verdi to Pyramid Lake consist of both native and introduced game and nongame species. The principal game fishes found in the system include brown trout, Lahontan cutthroat trout, rainbow trout, mountain whitefish, largemouth bass, black crappie, and channel catfish. The Lahontan cutthroat trout and mountain whitefish are the only native game fishes. Native nongame species include the cui-ui, tui chub, Lahontan redside, speckled dace, Tahoe sucker, Lahontan mountain sucker, and Paiute sculpin. The endangered cui-ui, Pyramid Lake sucker, uses the lower end of the river during years of high discharge to Pyramid Lake.

The USFWS (1979) recently determined the relative abundance and distribution of fishes in the Truckee River (Table J-1). The study showed that at least 13 species inhabit the river reach from the Verdi Power Division to Steamboat Creek. Mountain whitefish were most abundant followed by Tahoe suckers, mountain suckers, brown trout, Lahontan redsides, and rainbow trout Within this same reach Tahoe suckers showed the greatest biomass, followed by mountain suckers, mountain whitefish, brown trout, and rainbow trout (Table J-1). Paiute sculpins were commonly found in association with salmonids; however, the sampling technique employed (electro-shocking) produced inadequate sampling results for quantitative comparisons.

Downstream from the largest population of salmonids and sculpins, where the size and abundance of pools increase and slower water predominates, the Tahoe sucker, mountain sucker, Lahontan redside, carp and green sunfish become increasingly abundant. The largest number of species and biomass occurred from Steamboat Creek to Derby Dam. The Tahoe sucker was dominant, both in abundance and biomass. Other dominant species included the mountain sucker, Lahontan redside, carp and green sunfish. A 16-fold increase in carp biomass occurred in this stretch of the river over that found from Verdi Division to Steamboat Creek. Mountain sucker biomass was third in importance. This reach of the river is most directly affected by the existing JWPCP discharge. Although it contains a lesser quantity of trout than upstream reaches, it supports a recreational fishery for trout as well as bass, crappie, and catfish.

Twelve fish species were sampled in the lowest reach of the stream from Derby Dam to Pyramid Lake. Although the number of species was least in this section of the river,

Table J-1

RELATIVE ABUNDANCE/BIOMASS (kg) OF FISHES SAMPLED FROM VERDI POWER DIVERSION TO PYRAMID LAKE

Species[1]	Verdi to Steamboat Creek	Steamboat Creek to Derby Dam	Derby Dam to Pyramid Lake[1]	Total
Brown trout	20,653/2,423.7	657/279.2	24/18.1	21,334/2,721
* Lahontan cutthroat trout	248/14.8	123/19.3	-	371/34.1
Rainbow trout	6,250/671.1	616/115.3	-	6,866/786.4
* Mountain whitefish	61,399/2,809	378/55.1	63/0.4	161,840/2,864.5
* Tahoe sucker	95,152/13,470	225,603/18,292.2	143,085/14,380.4	763,840/46,142.6
* Mountain sucker	50,741/2,864.6	78,112/2,228	563,345/6,824.1	692,198/11,916.7
Largemouth bass	608/7.9	322/13.3	444/7.2	1,374/28.4
Green sunfish	244/4.3	1,869/37.4	1,192/39.2	3,305/80.9
Black crappie	37/0.04	99/1.3	28/8.2	164/9.5
Sacramento perch		one specimen taken		
Channel catfish	-	238/1.2	-	238/1.2
Brown bullhead	-	523/47.7	14/1.4	537/49.1
Carp	433/525.6	32,655/8,651.7	150,386/14,307	183,474/23,484.3
* Lahontan redside	10,349/139.1	39,457/253.9	569,242/3,124	619,548/3,517
* Speckled dace	261/0.9	185/0.7	31,750/47.8	32,196/49.4
Goldfish	-	681/55.2	-	681/55.2
Golden shiner		one specimen taken		
* Paiute sculpin	abundant	common	-	-
Mosquitofish	-	abundant	common	-
Total	346,875/22,931	381,519/30,051.5	1,759,573/38,757.8	2,487,966/91,740.3

[1] Cui-ui were not found during this survey.

* Native species.

SOURCE: USFWS, 1979.

overall abundance was highest (Table J-1). The most abundant fishes included the Lahontan redside, mountain sucker, Tahoe sucker, carp, speckled dace, and green sunfish. The dominant species in terms of biomass were Tahoe suckers, carp, mountain suckers, and Lahontan redsides. Cui-ui were not sampled.

Specific habitat requirements for fishes in the Truckee River system have been described by Snyder (1917), Moyle (1976), LaRivers (1962), Koch (1972), and Johnson (1958). The Lahontan cutthroat trout as well as other salmonids (mountain whitefish, rainbow and brown trout), suckers (Tahoe sucker and mountain sucker) and redsides inhabit the colder reaches of the Truckee River.

Table J-2 lists the distribution, food preferences, habitat requirements and spawning needs of fishes occurring from Verdi to Pyramid Lake. Life history and habitat requirements for each of the fish species found in the Truckee River from Verdi to Pyramid Lake are discussed in the following section.

Mountain Whitefish (*Prosopium williamsoni*)

Mountain whitefish are found in lakes and large rivers throughout the Columbia River system, the upper Missouri and Colorado River systems, the Lahontan and Bonneville drainage systems and in most of Alberta and British Columbia river systems. This species inhabits small, turbid pools as well as cold, deep lakes. Whitefish are usually found in association with trout, sculpins, suckers and minnows. A variety of bottom-dwelling forms (snails, dragonfly larvae, chironomid midge larvae, mayfly larvae, caddisfly larvae, crayfish and amphipods) and lesser amounts of zooplankton and surface insects make up their diet. They will also feed on the eggs of other fishes as well as their own. Their diet is similar to that of trout and this similarity in food preference may result in interspecific competition.

The growth rate of whitefish varies, depending on habitat, availability of food and temperature regimes. At age one, whitefish average 6 to 14 cm TL and reach 20 to 33 cm at age four. Growth slows considerably after age four and by age six the average length ranges from 37 to 44 cm TL (Moyle, 1976).

Rainbow Trout (*Salmo gairdneri*)

Rainbow trout are native to the Pacific coast drainages and fresh waters west of the Rocky Mountains from New Mexico to the Kuskokwim River in southwestern Alaska. The popularity

Table J-2

FISHES OF THE LOWER TRUCKEE RIVER SYSTEM FROM VERDI TO PYRAMID LAKE

Species	Distribution[1]	Food Species	Habitat	Spawning Season	Spawning Substrate	N/I[3]
Mountain whitefish	Verdi to Derby	Benthic invertebrates, zooplankton, surface insects	Streams with large pools	Oc-early De	Loose gravel	N
Rainbow trout	Verdi to Derby	Drift organisms, active benthic invertebrates	Clean, cool, fast-flowing, permanent streams and rivers, cold, deep waters of lakes	Fe-Jun (Jul-Au)	Gravel riffle	I
Lahontan cutthroat trout	Verdi to Pyramid Lake	Drift organisms, fishes	Variety of cool waters from small to large mountain lakes, major rivers to small tributaries	Ap-Jul	Gravel riffle	N
Brown trout	Verdi to River Mouth	Drift organisms, benthic invertebrates, fishes	Medium to large, slightly alkaline, clear streams with swift riffles and large, deep pools	No-De	Gravel Riffle	I
Tui chub	Pyramid Lake [2]	Invertebrates, aquatic plants	Weedy, rocky shallows of lakes or the quiet waters of sluggish rivers	late Ap-late Jun	Sandy bottom	N
Lahontan redside	Verdi to Pyramid Lake	Invertebrates, Tahoe sucker eggs	Lower courses of rivers in deep, quiet water, slow riffles, quiet, shallow pools	late Ma-Au	Sand and gravel areas of pools	N
Speckled dace	Verdi to Pyramid Lake	Benthic invertebrates, crustaceans	Cool, flowing rocky-bottom permanent streams and rivers, large lakes on rocky or sandy bottoms	Jun-Jul	Gravel edge of riffles	N
Golden shiner	Reno to River Mouth?	Zooplankton, flying insects	Warm ponds, lakes and sloughs associated with dense mats of aquatic vegetation	Ma-Au	Submerged vegetation and bottom debris	I
Goldfish	Reno to Derby Dam	Phytoplankton, zooplankton organic detritus, aquatic macrophytes	Fertile ponds and sloughs with heavy growths of aquatic vegetation	Ap-Ma	Aquatic vegetation, flooded grass, roots, leaves	I
Carp	Reno to Pyramid Lake	Plankton, benthic invertebrates	Warm, turbid water, generally associated with eutrophic waters with silty bottoms	Spring-early Summer	Weedy areas	I
Tahoe sucker	Verdi to Pyramid Lake	Algae, benthic invertebrates	Moderate depths in large lakes, shallow water in tributary streams	Ap - early Jun	Rock and gravel	N
Cui-ui	Pyramid Lake	Zooplankton	Pyramid Lake and lower Truckee River during spring spawning runs	Ap-early Jul	Bar or gravel bed	N
Mountain sucker	Verdi to River Mouth	Algae, invertebrates	Pools behind submerged rocks or logs in swift water	Late Jun-mid Jul May-mid Aug?	Gravel riffle	N
Brown bullhead	Reno to River Mouth	Aquatic insects, crustaceans, molluscs	Ponds, small lakes, river backwater, small stream pools with warm, turbid water, muddy bottom, slow current	Jun-Jul	Moderate to heavy submerged vegetation	I
Channel catfish	Reno to Derby Dam	Invertebrates, fishes	Clear, rapidly flowing, warm-water streams with sand, gravel or rubble bottoms	Ap-Jun	Muskrat burrows undercut banks, log jams	I
Mosquitofish	Reno to Pyramid Lake	Mosquito larvae and pupae, algae, zooplankton, fishes, terrestrial insects, aquatic invertebrates	In brackish sloughs, shallow stagnant ponds and the shallow edges of lakes and streams	Ap-Se	Nonspecific	I
Sacramento perch	Reno to Pyramid Lake	Crustaceans, aquatic insects, fishes	Sloughs, sluggish rivers, lakes	mid Jun-early Au	Heavy growth of aquatic macrophytes or filamentous algae	I

Table J-2

Species	Distribution[1]	Food Species	Habitat	Spawning Season	Spawning Substrate	N/I[3]
Green sunfish	Verdi to River Mouth	Invertebrates, small fishes	Small, warm streams, ponds and lake edges	Ma-Au	Fine gravel	I
Black crappie	Reno to River Mouth	Zooplankton, aquatic insects, fishes	Large, warm, clear lakes and reservoirs with large beds of aquatic plants	Ma-Ap	Mud to gravel	I
Largemouth bass	Reno to River Mouth	Invertebrates, fishes	Farm ponds, lakes, reservoirs, sloughs and river backwater with aquatic plants	Ap	Sand, gravel, or debris-littered bottoms	I
Paiute sculpin	Reno up Derby Dam	Benthic invertebrates, insect larvae, other sculpins	Aquatic weed beds in deep water lakes, rocky riffle sections of clear, cold mountain streams	Ma-Jun	Under rocks	N

[1] Known or expected distribution.
[2] Present occurrence undetermined.
[3] N/I = Native/Introduced

SOURCES: Environmental Protection Agency, 1977; Moyle, 1976; LaRivers, 1962; and Scott and Crossman, 1973.

of this species as a game fish has resulted in its widespread introduction in the eastern United States as well as other countries. Freshwater populations of rainbow trout are typically found in cool, clear, fast-flowing streams and rivers with an abundance of riffles and gravel bottoms. Although rainbow trout can survive temperatures of 0° to 28°C, they are most successful in habitats with temperatures of 21°C or lower (Scott and Crossman, 1973; Moyle, 1976; McAfee, 1966). Generally, rainbow trout occur in association with brown trout, sculpins and speckled dace. Where brown trout and rainbows occur together, brown trout will inhabit the slow, deep pools, while rainbows occupy the faster waters.

The feeding activity of rainbow trout peaks around dusk. Their food preference varies depending on the time of year. During the summer, they feed on terrestrial and aquatic insects, amphipods and snails. Other fishes and fish eggs may also be consumed. In the winter, rainbow trout concentrate on bottom-dwelling invertebrates.

Spawning activity is triggered when water temperatures range between 10° and 15°C. Spawning generally occurs from February through June; however, in higher elevations, low temperatures may delay spawning until July or August. Growth rates vary, depending on water temperature, feeding conditions, age at maturity, and other factors.

Lahontan Cutthroat Trout (*Salmo clarki henshawi*)

See Appendix I, ENDANGERED AND THREATENED SPECIES.

Brown Trout (*Salmo trutta*)

Brown trout, originally native to Europe and western Asia, have been successful in North American waters since 1883 (Moyle, 1976). They were probably introduced into Nevada waters in 1895 from a plant of about 250 loch leven trout (*Salmo trutta levenensis*) in Weber Lake, California (LaRivers, 1962). Weber Lake drains via the Little Truckee River into the Truckee River. It is believed that some of the fish planted were typical brown trout and not the loch leven variety.

Brown trout are bottom dwellers that prefer medium to large sized, slightly alkaline, clear streams with both swift riffles and large, deep pools. The optimum temperature range for brown trout is 18.3° to 23.9°C (Scott and Crossman, 1973). Small trout (less than 25 cm TL) display both territorial and hierarchical behavior. The largest, most aggressive fish defends the largest territory which is usually situated in a prime location with respect to cover and food availability (Moyle, 1976). Trout larger than 25 cm TL tend to be more mobile, although they display, to a lesser extent, territorial behavior.

Feeding is most intense at dawn and dusk. Small trout are insectivorous, feeding largely on drift organisms. Prominent items in the diet of large fishes are crayfish and other fishes (including their own young).

Spawning occurs during the fall and winter months in streams with gravel riffles. Generally, brown trout utilize the same spawning grounds as brook trout; however, the spawning activity of the latter is usually completed before brown trout begin.

Brown trout can reach a large size; however, growth varies depending on the habitat. In California waters, they average 5 to 7 cm TL during the first year, 13 to 16 cm during the second, 19 to 28 cm in their third and 35 to 41 cm in their fourth (Moyle, 1976).

Tui Chub (Gila bicolor obesa)

The tui chub is both a lacustrine and fluvial inhabitant commonly found in weedy shallows of lakes or quiet waters of sluggish rivers. In large, deep lakes, tui chubs form large schools in shallow water. Adults tend to move into deep water (down to 50 m) during the day and return to the shallow water at night. During the winter they occupy the deeper portions of lakes, presumably in a semidormant state. The spring reappearance of chubs in shallow water usually occurs in mid-May.

Tui chubs are omnivorous, opportunistic feeders. Examinations of the stomach content of tui chubs sampled from Pyramid Lake revealed that the major food items were algae and zooplankton (Johnson, 1958). Burns (1966) described the different food preferences during various life stages of tui chub in California. He found that newly hatched young feed on rotifer, diatoms, desmids and other microscopic materials. Young-of-the-year feed primarily on cladocerans and copepods. Adults feed on plankton, insects, crustaceans and plant materials.

The growth rate of tui chubs is comparatively slow. During their first summer they average 22 to 42 mm SL. Subsequent growth adds an average of 20 to 50 mm depending on the body of water. Tui chubs are important as forage fish, particularly for trout and largemouth bass, because of their high reproductive rate, slow growth rate, and preference for shallow areas where many game fish feed (Moyle, 1976).

Lahontan Redside (Richardsonius egregius)

The Lahontan redside is uniformly distributed throughout the streams, rivers and lakes of the Lahontan drainage system. Snyder (1917) found the redside in the lower courses of rivers in deep, quiet waters, as well as the swift currents of high mountain tributaries. Its size typically ranges from about

34 to 77 mm. Generally, redsides favor slow riffles and quiet pools over submerged bars. In lakes, they congregate in large schools, swimming about submerged logs, tops of fallen trees, wharves and sheltered areas. Redsides swim in large schools close to the surface over areas having a rocky bottom. During winter months, when the temperature drops below 10°C, the redside disappears from the shallow areas and presumably spends the cold months relatively dormant on rocky bottoms 3 to 18 m deep (Evans, 1969 as cited by Moyle, 1976).

Redsides are opportunistic feeders. Their diet consists of surface insects (butterflies and moths, beetles, wasps and ants), bottom insects (larvae of chironomid midges, blackflies, aquatic beetles and stoneflies) and minor predation of Tahoe sucker eggs (Moyle, 1976).

Spawning occurs from late May through August. Peak spawning activity occurs during the last 2 weeks of June when the water temperature is between 13° and 24°C. Redsides migrate up tributaries to spawn on the sand and gravel areas at the downstream end of pools or they spawn in shallow areas along the shore, with bottoms of gravel or small rocks.

Speckled Dace (Rhinichthys osculus)

Speckled dace are widely distributed in lakes and streams of the Lahontan drainage system and other systems in California and Nevada. They frequently occur in the shallow waters of streams, swimming near the bottom or among the rocks in riffles. In lakes, they are generally found on rocky or sandy bottoms.

Most feeding activity occurs at night. They prefer a diet dominated by benthic invertebrates, flying insects and zooplankton. Occasionally, speckled dace consume small quantities of eggs and the larvae of suckers and minnows. There is some evidence that dace compete with young trout for food and space, although in large lakes, such as Pyramid Lake, the habitat preference and feeding behavior of dace result in the utilization of food which is largely unavailable to trout.

Age and growth studies utilizing the scale method have been unreliable as indicators of age (Carlander, 1973; Moyle, 1976). Length frequency data collected from dace populations in Trinity River show that age one fish range from 3.2 to 4.0 cm TL, age two males range from 4.4 to 4.9 cm, age two females range from 5.0 to 5.2 cm and age three males and females range from 5.4 to 5.9 cm and 6.2 and 6.6 cm, respectively (Carlander, 1969).

Golden Shiner (Notemigonus crysoleucas)

The golden shiner is native to eastern North America but has been extensively introduced elsewhere as a bait fish. Shiners are usually found in slow moving waters of lakes and streams with abundant vegetation. They can survive low oxygen levels and temperatures as high as 35°C.

The diet of shiners consists of cladocerans, flying insects, chironomid pupae and filamentous algae. Spawning takes place from April through July. Warm water is more conducive to shiner growth (Moyle, 1976). Growth rates of shiners in lowland California ponds during their first year is about 7.6 cm TL. This rate is considerably lower for populations in higher, colder waters. In such streams, shiners will reach about 3.6 to 4.6 cm TL during their first year.

Goldfish (Carassius auratus)

Goldfish were originally native to eastern Asia but have been widely introduced, either accidentally or intentionally, throughout the world. Wild populations are commonly found in warm waters with dense aquatic vegetation and sometimes relatively low oxygen levels. Feeding occurs during the day. Young-of-the-year concentrate on zooplankton and aquatic insect larvae. Older fishes prefer phytoplankton, zooplankton, organic detritus and aquatic macrophytes. Occasionally insects and small fishes are also consumed.

Spawning takes place during May and June when water temperatures are between 15° to 23°C. Growth varies, depending on the water body. At the end of their first year, goldfish range in length of 1.5 to 10.5 cm TL. Older fish may exceed 25 cm.

Carp (Cyprinus carpio)

The Asiatic carp has been extensively planted in the United States and other parts of the world. The original intent of their introduction was to supplement game fish species diversity. Since their introduction, however, carp have been more commonly associated with "rough" fishes in the United States. They have become a nuisance species in most waters where they compete with or destroy the habitat of preferred game species.

Carp abound in eutrophic waters having silty bottoms and abundant growths of submerged and emerged aquatic vegetation. Carp are a hardy species and can withstand very high turbidity, temperature extremes and low oxygen concentrations. They are active at water temperatures from 4° to 24°C; however, the optimum temperature for growth is about 24°C.

Carp are omnivorous bottom feeders. Young fishes feed on zooplankton and phytoplankton. Larger specimens feed heavily on aquatic plants, algae, aquatic insect larvae, crustaceans, molluscs and annelid worms. Carp will frequently uproot submerged aquatic vegetation. This can be detrimental to native fish populations which depend on the vegetation for cover, food and spawning sites.

Spawning occurs during the spring and early summer when the water temperature exceeds 15°C. Growth is extremely variable in carp populations depending on the summer water temperatures, length of growing season, quality of water and food availability. Carp average 10 to 15 cm SL by age one. During the second year they can double in length and add 10 to 12 cm in each subsequent year (Moyle, 1976).

Tahoe Sucker (Catostomus tahoensis)

The Tahoe sucker is a common fish found in the Lahontan drainage system. It occurs in a variety of habitat types, but does best, in terms of maximum size and abundance, in large lakes. Adult suckers are generally found in waters of moderate depths while the young inhabit shallow water or tributary streams. Tahoe suckers are important forage fish for trout and are usually found in association with rainbow trout, cutthroat trout, tui chub, Lahontan redside and speckled dace.

Tahoe suckers are nocturnal feeders, primarily of algae and benthic invertebrates. Stomach analyses of adult suckers from Pyramid Lake indicated that the dominant food consumed by suckers consisted of algae, ostracoda, copepoda and cladocera (LaRivers, 1962). The growth rate of Tahoe suckers in Lake Tahoe is relatively constant, averaging 25 to 33 cm annually for fish two to eleven years old.

Spawning occurs in both lakes and streams from April to early June, depending on water temperature and altitude. In lakes, spawning takes place over rock and gravel bottoms at depths of 5 to 18 m. In streams, suckers use the same gravel beds used by rainbow trout several months earlier (LaRivers, 1962). Stream spawners generally migrate upstream at night when water temperatures reach 11° to 14°C. LaRivers (1962) reported that Tahoe suckers migrated from Pyramid Lake over 50 miles up the Truckee River in about a week.

Cui-ui (Chasmistes cujus)

See Appendix I, ENDANGERED AND THREATENED SPECIES.

Mountain Sucker (Catostomus platyrhynchus)

The mountain sucker is a fluvial species of the Lahontan drainage system. It typically inhabits small, clear streams with rubble, sand or boulder bottoms. Mountain suckers are generally found in pools containing aquatic macrophytes or behind submerged rocks or logs in swift water.

A preponderance of algae, small invertebrates and detritus material make up the food items consumed by mountain suckers. Plant materials seem to be the most important item in their diet; therefore, it is unlikely that they would compete with trout sharing the same stream segment.

Suckers spawn in gravel riffles next to pools during late June and through mid-July when the water temperature is between 10° and 19°C (Scott and Crossman, 1973). Growth during the first year ranges from 6 to 7 cm TL. In subsequent years, 1 to 2 cm TL is added to their length.

Brown Bullhead (Ictalurus nebulosus)

The brown bullhead has been introduced into waters throughout the United States from fresh waters of eastern and central North America. It is usually found on or near the bottom in the shallow areas of warmwater ponds, lakes and slow-moving streams with extensive aquatic vegetation and sand to mud bottoms. They can survive in waters ranging from near 0° to 37°C. Optimum temperatures, however, range between 20° to 35°C.

Bullheads are nocturnal bottom feeders. Small fishes feed largely on chironomid larvae, cladocerans, ostracods, amphipods and mayflies. Larger fishes concentrate on insect larvae and fishes.

Spawning occurs during May and June when water temperatures reach 21.1°C. Bullhead growth is rapid. Average growth for age groups one through four is 7 to 10 cm TL, 10 to 14 cm, 14 to 20 cm, and 19 to 28 cm, respectively.

Channel Catfish (Ictalurus punctatus)

Channel catfish commonly inhabit cool, deep, clear water with sand, gravel or rubble bottoms. These fishes have been widely introduced into suitable waters throughout the United States.

Originally, they ranged from the Mississippi and Missouri River systems southward into northeastern New Mexico. Fluvial adult populations are largely sedentary and are usually found in pools, beneath log jams, or under cut banks. They usually move into riffles to feed at night.

Small catfish prefer crustaceans and aquatic insect larvae, while fish and crayfish are important diet items for the larger fishes.

Spawning takes place from April through June when temperatures are between 21° to 29°C. Channel catfish tend to be fast growers. By the end of the first year their average size ranges from 7 to 10 cm TL; 12 to 20 cm in the second year, 20 to 38 cm in the third, 30 to 40 cm in the fourth and 35 to 45 cm in the fifth. The best growth is recorded where the oxygen concentration is above 3 ppm and the temperature above 21°C.

Mosquitofish (Gambusia affinis)

The mosquitofish is a native inhabitant of the eastern United States and New Mexico, from New Jersey and Illinois, south to the Gulf of Mexico. These fishes are well adapted to the warm, shallow edges of ponds, lakes and streams. Mosquitofishes have been planted in many streams and ponds for mosquito abatement.

It is apparent that mosquito larvae and pupae make-up a substantial part of the diet of mosquitofish; however, these fishes are opportunistic and will consume other food items including filamentous algae and diatoms.

Spawning takes place from April through September. Growth is dependent on sex, productivity of the water and temperature (Moyle, 1976). Growth is best in bodies of water having high productivity and long periods with warm water temperatures.

Sacramento Perch (Archoplites interruptus)

The Sacramento perch, which originally inhabited sloughs, sluggish rivers and lakes of the Central Valley, is the only native centrarchid west of the Rocky Mountains. The population in its native range has declined as a result of egg predation by exotic species (e.g., catfish and carp) but most importantly from interspecific competition with other introduced centrarchids. Since their decline, Sacramento perch have been successfully introduced in other drainages within California, Utah, Colorado, Nebraska, North Dakota, South Dakota and Nevada (LaRivers, 1962; Moyle, 1976). Sacramento perch were established in the Truckee River drainage during 1889 (Johnson, 1958). LaRivers (1962) reported these fishes to be very common in Pyramid Lake, but until recently, were rarely taken.

Sacramento perch are found close to the bottom near areas of rock, gravel or rooted vegetation. Active feeding occurs during the early morning and evening hours with slight activity occurring during the remainder of the day. Sacramento perch are highly opportunistic feeders and will take advantage of superabundant prey species. The principal diet of small perch is insects, while larger specimens feed primarily on other fish. Moyle (1976) indicated that the young-of-the-year favor small crustaceans (e.g., amphipods, cladocerans, ostracods and copepods). As they increase in size, aquatic insect larvae and pupae are consumed. In large bodies of water such as Pyramid Lake, fish over 9 cm TL feed primarily on cyprinids and smaller Sacramento perch.

Spawning generally takes place from mid-June through early August in Pyramid Lake when water temperatures are between 21° and 29°C. Sacramento perch in Pyramid Lake usually range between 35 to 42 cm TL at age nine (Moyle, 1976).

Green Sunfish (Lepomis cyanellus)

Green sunfish are native to the eastern United States from the Great Lakes to Mexico and the Alleghenies to the Mississippi drainage system. Widespread introductions have expanded their distribution to the western states. They are commonly found in small warmwater lakes and slow-moving streams.

Sunfish are opportunistic feeders. Young fishes prefer crustaceans and aquatic insect larvae while adults consume mosquito fish and small sunfish, including their own young (Moyle, 1976).

Spawning activity peaks during May and June when water temperatures range between 20° and 28°C. Green sunfish are extremely slow growers and they rarely obtain a size large enough to be considered a game species. Usually, they range between 3 to 5 cm TL during the first year, 5 to 10 cm during the second and 8 to 13 cm during the third.

Black Crappie (Pomoxis nigromaculatus)

Historically, black crappies were restricted to fresh waters from the upper Mississippi Valley east to New Jersey and south to Texas and Florida. They have since been widely introduced into suitable waters throughout the United States. Crappies are a popular game fish commonly found in large, clear, calm, warmwater ponds, small lakes, bays, shallow areas of large lakes, and areas of low current in large rivers. Within these habitat types, crappies are usually associated with heavy growths of aquatic vegetation and sandy to muddy substrate.

The diet of an adult crappie consists of crustaceans, insects, and fishes. Zooplankton and small Diptera larvae constitute the diet of smaller fishes.

Spawning occurs during late spring and early summer when water temperatures range between 12.8° to 16.1°C. (LaRivers, 1962). Growth rates of crappies in California waters (Goodson, 1966) showed that by age one the average length ranged between 3.7 to 6.5 cm TL, and by age five, 26.7 to 32.7 cm.

Largemouth Bass (*Micropterus salmoides*)

Largemouth bass originally inhabited fresh waters of the lower Great Lakes, the central part of the Mississippi River system, south to the Gulf coast, Florida and north on the Atlantic coast to Virginia (Scott and Crossman, 1973). They are usually found in water bodies having dense growths of aquatic vegetation. The popularity of this species as a warmwater game fish has resulted in its widespread introduction in waters throughout the United States.

Adult largemouth bass are largely piscivorous. They often compete with other sunfish and shallow water piscivorous fish for food and spawning sites. Young bass will generally compete with other small fishes that feed on zooplankton and small invertebrates.

Bass spawning takes place from late spring to early summer when water temperatures are between 16.7° to 18.3°C. Growth is variable. Average growth from age one to four is 5 to 20 cm TL, 7 to 32 cm, 15 to 37 cm, and 20 to 41 cm, respectively.

Paiute Sculpins (*Cottus beldingi*)

Paiute sculpins are an abundant bottom fish found in the Lahontan, Bonneville and Columbia River drainage systems. The habitat preference of sculpins is similar to that of salmonids. They favor the rocky riffle sections of clear, cold mountain streams. Paiute sculpins are common in Lake Tahoe and other high tributaries entering the lake but absent in Pyramid Lake where the waters are too warm and spawning habitat is lacking (LaRivers, 1962).

The feeding activity of the sculpin is year-round but diminishes in the fall and winter. A large part of their diet is aquatic insect larvae (mayflies, stoneflies and caddisflies). Within the Truckee river, sculpins may be considered to be somewhat of a competitor with trout; however, they generally utilize the larvae stages of insects while trout frequently utilize the emerged insect as a winged adult. In all other respects, the relationship of sculpins and trout is a positive one (Moyle, 1976). There is no apparent predation of trout eggs in Lake Tahoe. In stream populations, interspecific competition of trout and sculpins is minimal. Basically, sculpins serve as an available forage species for trout.

Spawning takes place from April to early July. Since sculpins are scaleless, age and growth studies are relatively difficult. Length-frequency analyses of sculpins are also poor indicators of age-length relationships. The only measure which has been used with some degree of confidence is the examination of otoliths for annual rings. Otolith examination of sculpin populations in Lake Tahoe and Sagehen Creek showed similar growth rates (Moyle, 1976). By the end of the first summer, age zero sculpins ranged between 2.6 to 3.6 cm TL and by age five, 9.3 to 9.7 cm.

Wildlife and Recreational Resources

Truckee River

The Truckee River corridor and lower Truckee River supports an important wildlife community due to the availability of water and associated riparian habitat. The diverse vegetation characteristic of riparian areas allows them to support a more concentrated and diverse wildlife population than surrounding dry areas. Riparian habitat in Nevada is relatively scarce with the Truckee River supporting one of the principal riparian corridors in the state, thus, making this area even more valuable to wildlife and their beneficial uses.

Waterfowl, including Canada goose, mallard, pintail and teal, utilize the Truckee River corridor and lower Truckee River in sufficient numbers to support sporadic hunting activities. The endangered bald eagle winters along the Truckee River corridor and the endangered peregrine falcon is a sporadic migrant through this area. Eight prairie falcon and four golden eagle aeries have also been sighted along the Truckee River corridor (Herron, pers. comm.). Of the 309 species of birds found in Nevada, approximately one-third are found in this area (Oakleaf and Klebenow, 1975), indicating the exceptional species diversity and importance of this habitat.

Mammals such as beaver, mink and long-tailed weasel inhabit the area (Mollini, pers. comm.). Other wildlife species primarily found in canyons surrounding the Truckee River, such as mule deer, chukar partridge, California quail and mourning dove, also make use of the riparian corridor.

Although the riparian habitat continues to support a greater diversity and population of wildlife than surrounding areas, this wildlife habitat and the supported wildlife populations have significantly declined as the Truckee River Basin developed. Historically, the riparian habitat below Verdi consisted of extensive groves of large cottonwoods with smaller scrubs forming dense thickets and understory consisting primarily of buffalo-berry and willow (Oakleaf and Klebenow, 1975). This riparian habitat has since been reduced to a thin discontinuous ribbon of cottonwoods and shrubs along the river.

Although extensive deterioration of this habitat has occurred, it is still a very valuable wildlife area and should be protected. It is possible that this habitat will be at least partially restored in the future.

In addition, the Truckee River from Stateline to Wadsworth is one of the most heavily fished rivers in Nevada and thus a valuable recreational resource. Estimates made by the NDW indicate that fishing, angler days, ranged from about 121,000 to 227,000 between 1970 and 1978 (Table J-3). Fishing in the river exceeded the total annual angler days of Pyramid Lake and Lahontan Reservoir and at times equaled or exceeded their combined use during any 1 year (Table J-3). In addition, the total annual catch of fish in the Truckee River from Stateline to Wadsworth exceeded the total combined numbers of fish caught in Pyramid Lake, Lahontan Reservoir, Stillwater WMA, Fernley WMA, Truckee Canal and the Lahontan Valley (as defined in Table J-3). These data illustrate the importance of the Truckee River's sport fishery.

Game fish caught in the Truckee River are rainbow trout, rainbow-cutthroat trout hybrids, cutthroat trout, brown trout, and mountain whitefish. Among these fish the first three are most abundant in the total catch, and this fishing is primarily supported by planting hatchery-reared fish. Brown trout and whitefish that occur in the catch are wild or naturally produced fish (Sumner, pers. comm.; Sumner memorandum). The Truckee River is considered by the NDW to be a coldwater stream from Stateline to Derby Dam. During periods of sufficient seasonal flow below Derby Dam, the Truckee River supports a recreational fishery for planted trout from Derby Dam to Wadsworth.

Table J-3. Fishing Use Data*

Year	Angler Days						Catch					
	Truckee River	Pyramid Lake	Lahontan Reservoir	Truckee Canal	Stillwater WMA	Lahontan Valley**	Truckee River	Pyramid Lake	Lahontan Reservoir	Truckee Canal	Stillwater WMA	Lahontan Valley
1970	157,177	141,614	54,507	651	5,193	22,746	-	-	-	-	-	-
1971	134,787	105,186	85,257	3,024	9,396	32,637	-	-	-	-	-	-
1972	121,297	105,038	94,759	-	6,664	33,090	-	-	-	-	-	-
1973	157,875	94,529	123,734	-	5,409	33,387	-	-	-	-	-	-
1974	177,277	97,297	123,513	2,480	8,659	28,797	-	-	-	-	-	-
1975	193,599	102,902	106,353	1,098	4,097	25,044	-	-	-	-	-	-
1976	162,857	892,249	56,417	-	2,884	16,588	384,552	49,216	225,336	-	13,423	47,020
1977	154,924	78,486	45,017	923	1,142	13,289	374,167	53,208	170,442	1,618	14,170	34,555
1978	226,851	58,274	52,333	1,543	2,331	20,232	528,488	51,231	122,290	9,669	10,892	52,239

SOURCE: NDW fishing use data records. Available from the NDW, Reno, Nevada.

* The data presented represent the projected or expanded fishing effort based on creel census surveys conducted by the NDW at the end of the fishing season.

**Includes Carson River (Churchill County portion), V-Canal, Canvasback Marsh, Carson Lake, Harmon Reservoir, Indian Lake, Rattlesnake Reservoir, Sheckler Reservoir and Soda Lake.

Although the NDW has not differentiated fishing effort by reach along the Truckee River in its annual fishing use data, the department did conduct a separate study during 1976 and 1977 which included this disaggregation of the data. During 1976, the first of the recent drought years, approximately 84 percent of fishing occurred above the JWPCP, 10 percent between the JWPCP and Derby Dam, and 6 percent between Derby Dam and Wadsworth. During 1977, the most severe of the drought years, fishing between the JWPCP and Derby Dam dropped from 6 to about 1 percent and to less than 0.25 percent between Derby Dam and Wadsworth. These data are thought to identify the significance of instream flow on the sport fishery below the JWPCP. For example, the range of flows at Vista, below the JWPCP, during May 1976 and 1977 were 552 to 953 cfs and 174 to 389 cfs, respectively. Below Derby Dam at Wadsworth during the same periods of time the instream flow was 264 to 531 cfs and 38 to 55 cfs, respectively, which marked a considerable difference in flow between the two dry years. It should be noted that during low flow years the NDW does not stock fish in areas where low flow and high temperature could jeopardize the survival of fish. Thus, in some years the Truckee River may be stocked above the JWPCP but not below the JWPCP (Sumner, pers. comm.).

It is recognized that 1976 was also a below normal water year. Consequently, it is possible that fishing the Truckee River below the JWPCP could be higher than the percentage shown above during normal or above average water years. In addition, arguments are made by the NDW and other fishing interests that if the aquatic habitat below the JWPCP could be returned to its natural condition this reach could become as valuable for sport fishing as the reach above the JWPCP.

Other recreational activities along the Truckee River below the JWPCP are trapping, hunting, swimming, and miscellaneous aquatic-oriented activities, i.e., sightseeing and wildlife observation. The Truckee River supports most of the trapping activity in the area. The primary species trapped along the Truckee River are beaver, muskrat, mink, bobcat and gray fox (Mollini, pers. comm.). These species are trapped for their pelts which are sold. Waterfowl hunting is generally sporadic. Other species hunted along the river include chukar partridge, California quail and deer. There is no evidence that these uses are being influenced by water quality or quantity, although it is probable that waterfowl and aquatic furbearer populations would decline with reduced flows (Mollini, pers. comm.).

When adequate flow and water quality conditions exist, the reach between Vista and Wadsworth supports much use from swimming and other miscellaneous activities.

With the growing population and a corollary need for recreational resources, the importance of the Truckee River as a recreational resource is certain to increase in the future.

Anaho Island National Wildlife Refuge

Anaho Island, a bird rookery, lies in Pyramid Lake and entirely within the Pyramid Lake Indian Reservation. The island is about 1 mile wide and .50 mile long and presently covers nearly 750 acres. Its summit, which is about 600 feet above the lake surface, is at 4,377 feet in elevation. The volcanic rocks of the island are overlain with the calcareous deposits called tufa, characteristic of Pyramid Lake, which formed when the island was under the waters of the ancient Lake Lahontan. Vegetation is similar to that found on nearby shores except that big sagebrush, common on the mainland, is rare on Anaho Island. The more important plant species found on the island include shad scale, greasewood, winterfat, and fourwing saltbush (Woodbury, 1966).

The fauna of the island is unique and is of considerable biological interest. Anaho Island supports the largest and one of the few nesting colonies of white pelicans in North America, supporting a total population of as high as 16,000 in 1953 (Table J-4). The white pelican is piscivorous, feeding primarily on tui chubs and carp in Pyramid Lake and the shallow marshlands of the Stillwater Wildlife Management Area (75 miles southeast), Lahontan Reservoir (50 miles south), Walker Lake (90 miles south), and Washoe Lake (50 miles southwest) (Knopf & Kennedy, 1978).

It appears that the total population of white pelicans and production of young, while fluctuating from year to year, has declined since the island was established as a national wildlife refuge in 1913. This decrease is probably due to human disturbance (boating, fishing, aircraft) during the nesting season from both authorized and unauthorized persons (Woodbury, 1966). Other factors, such as the availability of food and predation, probably affected their decline, but the extent of these factors has not been documented.

The California gull is the second most abundant species utilizing Anaho Island. Although populations can vary substantially from year to year (i.e., total populations were about 800 in 1978 and 4,175 in 1979 [LeFever, pers. comm.]), populations also appear to be declining due to human disturbance. Double-crested cormorants, also experiencing declining production, great blue heron and Caspian tern also nest on Anaho Island. The relative abundance of wildlife species found on Anaho Island is given on Table J-5.

Table J-4. White Pelican Nesting and Production Records[1] At Anaho Island for the Years 1950-1965

(U. S. Fish and Wildlife Service, 1950-1965)

Year*	Colonies	Nests	Young	Total Estimated Population
1950	14		4,200	14,000
1951	11	5,650	3,742	15,000
1952	15	5,862	4,053	12,000
1953			3,803	16,000
1954			5,340	
1955		2,800		
1956		3,600		
1957	2	2,800		
1958	4	4,700	6,400	
1959	3	2,500	3,500	9,000
1960	3	3,600	4,000	7,500
1961			3,000	
1962	3	3,200	3,000	9,500
1963	3	1,000	2,500	8,500
1964	6	1,608	2,314	7,000
1965	4	1,600	2,700	7,500
1977				5,400[2]
1978				4,960[2]
1979			1,575[2]	5,775[2]

* Generally three trips made annually; one in May, June, and July.

[1] Source: Woodbury, 1966.

[2] Source: LeFever, pers. comm.

Table J-5. Relative Abundance of Wildlife Species Found on Anaho Island

Bird Species[1]	Sp	S	F	W
Eared grebe		c	c	
Western grebe	c	c	c	u
White pelican*	c	a	c	u
D. C. cormorant*	c	a	c	
Great blue heron*	c	c	u	o
Canada goose	u	u	o	u
Mallard		o	o	
Gadwall		o	o	
Pintail		o	o	
Bufflehead				o
Common merganser*	u	c	u	o
Turkey vulture		o		
Red-tailed hawk	o	u	o	
Marsh hawk*	o	u	u	o
Prairie falcon				o
American kestrel	u	u	u	o
American coot			u	
Killdeer*	o	u	u	
Marbled godwit	o		o	
Wilson's phalarope	o		o	
California gull*	c	a	c	
Heermann's gull		r		
Caspian tern*	o	u	o	
Mourning dove	o	o	o	
Barn owl	o	o	o	o
Rufous hummingbird		o	o	
Say's phoebe	o	u	o	
Common raven	u	u	o	
Canyon wren		o		
Rock wren	c	c	c	c
Mountain bluebird				o
Loggerhead shrike	o		o	
Yellow-rumped warbler (Audubon)	o		o	
Western meadowlark			o	
House finch	u	o		c
Savannah sparrow			o	
Dark-eyed junco				o
White-crowned sparrow	c	o	c	a
Song sparrow			o	o

[1] Horizontal lines separate each group or family of birds. Birds that nest on Anaho Island are followed by an *. The following legend describes the relative abundance categories and seasons of the year.

a - abundant - occurs in large numbers
c - common - occurs regularly in moderate numbers
u - uncommon - occurs regularly in small numbers
o - occasional - a few noted each year
r - rare - a few noted, but not each year

Sp- Spring - March-May
S - Summer - June-August
F - Fall - September-November
W - Winter - December-February

DATA SOURCE: Woodbury, 1966 in USFWS, 1975a.

Table J-5 (cont.)

Mammals

The only known mammal occurring on Anaho Island is the deer mouse (Peromyscus maniculatus), and it is quite common. This species is probably the primary food source for the island's rattlesnake population. There may be bats present on the island, but species and occurrence rate are not known.

Reptiles

Lizards.

Zebra-tailed lizard (Callisaurus draconoides) - common
Desert spiny lizard (Sceloporus magister) - common
Northern side-blotched lizard (Uta stansburiana stansburiana) - uncommon
Northern desert horned lizard (Phrynosoma platyrhinos platyrhinos) - rare
Western whiptail (Cnemidophorus tigris tigris) - abundant

Snakes.

Desert striped whipsnake (Masticophis taeniatus) - uncommon
Gopher snake (Pituophis melanoleucus) - uncommon
Western garter snake (Thamnophis elegans) - uncommon
Great Basin rattlesnake (Crotalus viridis lutosus) - common

An additional concern and one possibly affected by the Master Project is the potential exposure of a land bridge between the mainland and the island that can result from declining lake levels. Exposure of this land bridge could provide access to the island for humans and wildlife, potentially destroying the successful production of young birds, as has already occurred at Mono Lake, California. Upstream diversions and other uses of Truckee River water have reduced inflow to Pyramid Lake by about one-half, leading to a lowering in lake level (approximately 70-75 feet since 1906) over what would be expected due to natural climatic fluctuation alone. This has allowed the island's land area to increase from 250 acres in 1913 to the present 750 acres. In 1966, Anaho Island was about .25 mile from the mainland with a separating maximum depth of 20 feet. Unless lowering of the lake level is stopped the land bridge will be exposed (Woodbury, 1966).

Pyramid Lake

Pyramid Lake also supports much wildlife. The Pyramid Lake delta area is heavily used by wildlife, particularly by pelicans and Canada geese (Lorain, pers. comm.). As with all wetlands, this area is highly influenced by the amount of water flowing into the area from the Truckee River.

Due to its large size, its proximity to major urban areas (30 miles from Reno and Sparks and less than 200 from Sacramento), fishing for trophy fish, and its unique ecological features, Pyramid Lake is also an important recreational resource in Nevada. It supports a variety of water-oriented activities including fishing, boating, swimming, sightseeing, picnicking, and camping.

Fishing is the most important recreational activity at the lake. The Lahontan cutthroat trout and the three rainbow cutthroat trout hybrids, which are hatchery-reared stock, support the fishery. The Lahontan cutthroat trout is a sought after trophy-sized fish. Since 1969, the cui-ui fishery has been closed to non-Indians to reduce pressure on that endangered species. Sacramento perch are caught during the spring, summer, and fall months when trout are generally unavailable to the angler (DOI, 1977).

Pyramid Lake provides one of the best sport fisheries for Lahontan cutthroat trout in the country. Lahontan cutthroat trout caught from Pyramid Lake averaged about 23 inches in fork length and 5 pounds in weight in 1975. Trout in the 12-16 pound class are caught regularly and modern records of 21- and 24-pound Lahontan cutthroat and the hybrid bowcut, respectively, have been recorded. An average of 10 hours of fishing effort, however, is required for each "keeper"

(15-inch fish) (DOI, 1977; Lorain, pers. comm.). It appears that fishing, angler days, at Pyramid Lake generally declined between 1970 and 1978 (Table J-3).

Boating and water skiing are also very popular recreational activities at the lake. Most of the facilities for boating, swimming, picnicking and camping are located at Sutcliffe and Warrior Point on the west side of the lake. There are also many good undeveloped beaches around the lake, all of which are open to the public.

A recreational plan for Pyramid Lake has not been completed although the Pyramid Lake Indian Tribe is investigating recreational development in cooperation with the National Park Service (Strong, pers. comm.; DOI, 1977). A marina is planned for either Sutcliffe or Warrior Point (Strong, pers. comm.).

Stillwater Wildlife Management Area

The Stillwater Wildlife Management Area (WMA) is located in western Nevada about 18 miles northeast of Fallon. The Stillwater marshes are a remnant of the Pleistocene Lake Lahontan. The WMA presently encompasses almost 180,000 acres, including over 50,000 acres of private inholdings. In addition, about 24,000 acres of the total 180,000 acres have been set aside as the Stillwater National Wildlife Refuge. Sixteen primary waterfowl units with a potential water acreage of over 22,000 acres and three pasture acres of 2,420 acres have been developed on the WMA (USFWS, 1977).

All WMA lands are managed cooperatively with the NDW under a 1948 agreement with the Truckee-Carson Irrigation District (TCID). The entire area is located on public lands withdrawn for the Newlands Reclamation Project.

The Stillwater Marsh area provides most of the wildlife habitat. It includes approximately 22,000 acres of water area, when the Pelican Island area receives sufficient water. The marsh depends mainly on agricultural return flows from irrigated lands and no water rights have been established for the WMA. Drain flows were generally adequate from 1948 up to the 1960-61 drought. Since this time, flows have been marginal with only occasional years of good water receipts. The WMA can utilize an optimum 131,200 acre-feet of water per year, with approximately 91,400 acre-feet needed to maintain all water areas; the higher figure would provide for flushing of saline water. A minimum of 50,000 acre-feet of water may maintain a viable waterfowl area of much smaller acreage. Between 1972 and 1976 the net receipts have averaged 58,000 acre-feet (USFWS, 1977).

The Stillwater Marsh area has been an historic stopover point for migratory waterfowl during their spring and fall migration, as well as an important nesting site for many waterfowl, marsh and shorebirds. Peak numbers of 250,000 ducks, 10,000 geese and 13,000 whistling swans occur during good water years. Under ideal nesting conditions, waterfowl produce up to 15,000 young. Cinnamon teal, gadwall, and redhead are the principal nesting species. Stillwater is unique in providing a fall migration stopover and feeding location for an average of over 30 percent of the winter Pacific Flyway population of canvasback with a high of 56 percent in 1970. Stillwater WMA is also an important redhead nesting area, producing about 3,500 redhead young per year under good marsh conditions (USFWS, 1977). The relative abundance of bird species found at the Stillwater WMA is given in Table J-6.

The Stillwater WMA is an important area for hunting, fishing and miscellaneous activities including swimming, picnicking, and wildlife observation. Waterfowl hunting occurs from the first part of October to mid-January with open unrestricted hunting managed by the Nevada Department of Fish and Game. Both warmwater and coldwater fishing occurs on the WMA (USFWS, 1977). Total visits to the Stillwater WMA have generally been increasing since 1960 with miscellaneous activities and fishing use experiencing the most dramatic increase (LeFever, pers. comm.) (Table J-7). This trend is probably a result of the increased population of the area. Recreational use of Stillwater WMA is significantly affected by water availability, i.e., during dry periods the WMA will support fewer waterfowl and fish and thus will attract fewer hunters and fishermen, and thus any reduction inflows to the WMA will reduce both the wildlife habitat and recreational value of the WMA.

Table J-8 summarizes physical characteristics, waterfowl production and recreational use data for the Stillwater WMA and other important wetland areas in the lower Truckee and Carson River basins in 1973.

Fernley Wildlife Management Area

The Fernley Wildlife Management Area (WMA) is located about 5 miles east of Fernley and encompasses 13,655 acres. The Fernley WMA has two primary ponds and two dikes (constructed in 1950) with a potential developed wetland area of 10,000 acres, although presently less than 1,000 acres are suitable for waterfowl habitat (Barngrover, pers. comm.). The primary water source for these wetlands is irrigation return flows through the Fernley drain. Although wetlands found in this area historically are drying, the numerous upstream diversions and increased consumption of Truckee River water have significantly accelerated this trend.

Table J-6. Relative Abundance of Bird Species Found at Stillwater National Wildlife Refuge

Species	Sp	S	F	W
Common loon	r		r	
Horned grebe	r		r	
Eared grebe*	c	c	c	
Western grebe*	c	a	c	o
Pied-billed grebe*	u	u	u	o
White pelican	c	a	a	r
Double-crested cormorant	u	u	u	r
Great blue heron*	c	c	c	u
Common egret*	c	u	c	o
Snowy egret*	c	a	c	
Black-crowned night heron*	c	a	c	u
Least bittern	r	r	r	
American bittern*	r	a	r	
White-faced ibis*	u	c	u	r
Whistling swan	c		u	a
Canada goose (western)*	c	c	c	a
Canada goose (lesser)	r		o	c
Canada goose (cackling)	r		r	o
White-fronted goose			o	a
Snow goose	c		c	u
Blue goose	r		r	
Ross' goose	o		o	
Mallard*	a	a	a	c
Gadwall*	a	a	a	u
Pintail*	a	c	a	u
Green-winged teal*	a	u	a	u
Blue-winged teal*	a	o		
Cinnamon teal*	a	a	c	o
American widgeon*	c	o	a	u
Shoveler*	a	c	a	u
Wood duck*	u	u	u	
Redhead*	a	a	a	o
Ring-necked duck	u		u	
Canvasback*	c	o	a	u
Greater scaup	o		o	o
Lesser scaup	u		u	u
Common goldeneye	u		u	u
Bufflehead	c		u	c
Surf scoter			a	a
Ruddy duck*	a	c	a	u
Hooded merganser	o		o	o
Common merganser	c		u	c
Turkey vulture	u	u	u	
Sharp-shinned hawk	o	r		o
Cooper's hawk	o			o
Red-tailed hawk*	c	u	c	u

Table J-6 (cont.)

Species	Sp	S	F	W
Swainson's hawk*	o	u	o	
Rough-legged hawk	u		u	c
Ferruginous hawk	r			r
Golden eagle	u	o	u	u
Bald eagle	o			u
Marsh hawk*	c	c	c	a
Prairie falcon	a		a	u
Sparrow hawk*	c	c	c	c
California quail*	u	c	c	u
Ring-necked pheasant*	u	u	u	u
Virginia rail*	u	c	c	o
Sora*	u	c	c	o
Common gallinule*	r	o	r	r
American coot*	a	a	a	c
Semipalmated plover	o		o	
Snowy plover*	o	u	o	
Killdeer*	a	a	c	o
Black-bellied plover	o		o	
Common snipe*	u	o	u	o
Long-billed curlew*	u	u	u	r
Spotted sandpiper*	u	o	u	r
Solitary sandpiper	o		o	
Willet	o	o	o	
Greater yellowlegs	u	o	u	o
Lesser yellowlegs	o	r	o	r
Least sandpiper	a	u	a	
Dunlin	o		o	
Long-billed dowitcher	c	o	a	
Western sandpiper	c	a	a	o
Marbled godwit	o	u	u	o
Sanderling	r		r	
American avocet*	c	a	a	o
Black-necked stilt*	c	a	u	
Wilson's phalarope*	a	c	a	
Northern phalarope*	c	c	c	
California gull	c	c	o	r
Ring-billed gull	u	u	u	o
Bonaparte's gull	r	r	r	
Forster's tern*	u	a	o	
Caspian tern	o	o		
Black tern*	o	o		
Mourning dove*	u	c	c	o
Barn owl*	c	c	c	c
Screech owl*	u	u	u	u
Great horned owl*	c	c	c	c
Burrowing owl*	u	u	o	
Long-eared owl*	o	r	r	o
Short-eared owl*	o	r	u	c
Common nighthawk*	u	c	u	
Belted kingfisher	o	r	o	o
Red-shafted flicker*	c	c	c	c
Downy woodpecker*	o	r	r	o

Table J-6 (cont.)

Species	Sp	S	F	W
Western kingbird*	c	a	c	
Ash-throated flycatcher	o	o		
Say's phoebe*	u	u	o	o
Western wood pewee	u	u	u	
Olive-sided flycatcher	r	r		
Horned lark*	a	c	a	c
Violet-green swallow	u	u	u	
Tree swallow	c	u	u	
Rough-winged swallow*	u	o	u	
Barn swallow*	c	a	u	
Cliff swallow*	u	a	u	
Black-winged magpie*	c	c	c	c
Common raven*	u	c	c	u
Common crow*	r	r	r	r
Mountain chickadee				o
Common bushtit*	o	o	o	r
Bewick's wren*	u	u	u	r
Long-billed marsh wren*	c	a	c	u
Mockingbird*	r	r	r	
Sage thrasher*	o	o	u	
Robin*	u	u	u	o
Western bluebird	r		r	r
Mountain bluebird	r		r	r
Townsend's solitaire	o	o	o	r
Ruby-crowned kinglet	o		o	o
Water pipit	o		u	u
Cedar waxwing	r		r	
Northern shrike				u
Loggerhead shrike*	a	c	a	c
Starling*	c	u	c	c
Orange-crowned warbler	o		r	r
Yellow warbler	u	c	u	
Audubon's warbler	u		o	o
MacGillivray's warbler	o		o	
Yellowthroat*	o	o	c	
Yellow-breasted chat*	r	o	r	

Horizontal lines separate each group or family of birds. Species that are rare or endangered by extinction in the United States are in reverse print. Birds that nest locally are followed by an *. The following legend describes the relative abundance categories and seasons of the year.

a - abundant - occurs in large numbers
c - common - occurs regularly in moderate numbers
u - uncommon - occurs regularly in small numbers
o - occasional - a few noted each year
r - rare - a few noted, but not each year

Sp- Spring
S - Summer
F - Fall
W - Winter

Table J-7. Stillwater Wildlife Management Area
Fallon, Nevada

Statistics

Year	Waterfowl Production	Waterfowl Use-Days	Hunter Visits	Waterfowl Kill*	Fishing Visits	Miscellaneous Visits
1949	4,409	11,214,800	1,654	5,503	2,000	165
1950	10,670	8,920,000	2,021	3,496	2,800	250
1951	18,324	12,982,407	1,956	4,342	2,500	500
1952	15,595	15,105,554	2,580	5,728	3,300	500
1953	9,197	14,503,281	5,156	8,146	3,600	500
1954	24,521	22,011,859	6,466	16,553	3,500	750
1955	22,469	14,108,228	7,300	16,280	2,200	1,800
1956	27,065	17,736,622	6,500	15,650	2,200	2,000
1957	29,912	24,060,779	6,600	15,180	2,040	2,120
1958	41,475	40,326,579	10,000	23,000	3,800	2,350
1959	35,801	38,232,400	6,984	16,525	4,000	2,400
1960	3,675	15,865,066	2,210	1,217	2,800	2,500
1961	584	2,691,388	800	445	1,225	2,500
1962	1,875	19,481,329	1,500	3,420	500	2,500
1963	6,786	29,898,092	2,100	6,515	600	2,700
1964	10,934	34,149,388	4,000	11,010	1,000	3,200
1965	14,473	47,573,988	5,800	14,369	1,300	1,650
1966	9,956	22,603,350	6,788	10,120	7,148	4,075
1967	10,958	24,489,241	10,136	19,612	8,250	3,305
1968	15,730	24,052,812	11,989	17,542	4,186	1,700
1969	15,741	22,175,398	11,471	22,752	3,705	1,810
1970	18,142	26,164,460	9,670	21,226	5,175	5,016
1971	15,814	24,483,333	10,326	17,502	8,323	6,228
1972	12,869	18,669,365	6,339	8,757	10,924	5,902
1973	14,299	12,231,570	6,085	7,542	19,900	7,085
1974	8,272	10,016,980	3,800	5,000	17,900	9,082
1975	11,980	15,099,994	8,563	14,435	9,985	15,282
1976	4,280	7,106,061	3,725	4,000	18,775	8,496
1977	514	3,082,402	2,215	1,131	15,045	9,412
1978	-	-	4,850	8,999	8,375	8,707
1979	-	-	10,440	14,150	13,000	13,016

* Includes entire season kill, usually extended into January.

DATA SOURCES: USFWS, 1977 and LeFever, pers. comm.

Table J-8. Use of Lahontan Valley by Man, Waterfowl, Waterbirds, Shorebirds, and Raptors (1973)

Area	Inflow (acre-feet)	Acres of Wetland	Economic Benefits (AUMs)	Waterfowl Use Days				Total	Waterfowl Production			Total	Water & Marsh Birds	
				Swans	Geese	Ducks	Coots		Geese	Ducks	Coots		Use	Production
Fernley Wildlife Management Area		4,910	600	1,680	7,220	555,880	97,120	661,900	4	910	210	1,124	145,640	390
Massie & Mahala Slough Area		510	1,770	630	13,790	395,960	103,280	513,660	3	1,590	610	2,203	66,960	70
Soda Lakes Area		950	3,610	10	3,370	248,790	202,020	454,190	0	280	220	500	105,520	230
Old River Area		2,190		4,200	10	62,300	8,360	74,870	0	160	90	250	25,620	60
Sheckler Area		2,800	1,490	340	16,500	125,340	26,140	168,320	30	440	180	650	35,060	70
Fallon Farmland		1,160				416,430	62,720	479,150	0	710	220	930	663,140	260
Lahontan Reservoir														
Carson Lake	43,850	13,840	20,880 1,200 pelts	2,330	516,820	6,542,520	596,580	7,658,250	20	3,940	2,450	6,410	1,627,500	10,490
Harmon Area		1,280	1,780	140	9,140	136,820	28,000	174,100	10	300	140	450	67,310	130
S-Line Area		1,440		780	21,270	265,210	181,790	469,050	60	590	350	1,000	46,850	60
Canvasback Gun Club	18,220	3,120	4,800 600 pelts	110	17,320	275,100	42,140	334,670	4	780	350	1,134	183,890	640
Subtotal		32,200	34,930 1,800 pelts	10,220	605,440	9,024,350	1,348,150	10,988,160	131	9,700	4,820	14,651	2,967,490	12,400
Stillwater Wildlife Management Area	56,270	13,600	15,750 2,050 pelts	100,980	250,980	9,731,310	2,148,300	12,231,570	60	9,420	4,750	14,230	716,090	2,050
TOTAL		45,800	50,680 3,850 pelts	111,200	856,420	18,755,660	3,496,450	23,219,730	191	19,120	9,570	28,881	3,683,580	14,450

Table J-8 (cont.)

Area	Shorebird, Gull & Tern		Raptorial Bird		Hunting Visits	Hours of Use	Fishing		Wildlife Observation		Other Visits*	Hours of Use	Total	
	Use	Production	Use	Production			Visits	Hours of Use	Visits	Hours of Use			Visits	Hours of Use
Fernley Wildlife Management Area	130,690	410	4,960	10	1,800	9,000	700	2,800	880	880	50	350	3,430	13,030
Massie & Mahala Slough Area	125,790	360	3,910	5	650	3,250	20	80	3,010	750	40	40	3,720	4,130
Soda Lakes Area	211,210	520	4,010	10	750	3,750	20	80	1,960	1,960	70	2,500	2,800	8,290
Old River Area	93,020	150	2,030	5	420	2,120	160	640	440	440	20	240	1,040	3,440
Sheckler Area	187,470	410	3,610	10	880	4,400	1,330	5,320	1,140	1,140	200	1,400	3,550	12,260
Fallon Farmland	276,320	670	10,310	10	550	2,750	8,810	35,240	500	500	620	3,250	10,480	41,740
Lahontan Reservoir							123,730	494,920						
Carson Lake	4,379,870	9,860	5,430	10	5,440	27,200	50	200	150	150	0	0	5,640	27,550
Harmon Area	154,660	410	5,640	10	2,720	13,600	5,730	22,920	1,040	1,040	1,800	2,730	11,290	40,290
S-Line Area	190,060	340	5,340	10	3,950	19,750	2,510	10,040	1,660	1,660	150	800	8,270	32,250
Canvasback Gun Club	157,390	320	4,570	10	3,110	15,550	2,850	11,400	150	150	0	0	6,110	27,100
Subtotal	5,906,480	13,450	49,810	90	20,270	101,370	145,910	583,640	10,930	8,680	2,950	11,310	180,060	705,000
Stillwater Wildlife Management Area	2,271,530	7,220	82,060	230	8,830	44,150	19,900	77,700	2,950	7,600	7,210	35,350	38,890	164,800
TOTAL	8,178,010	20,670	131,870	320	29,100	145,520	165,810	661,340	13,880	16,280	10,160	46,660	218,950	869,800

*Includes environmental education and photography visits.

SOURCE: DOI, 1977.

The Fernley WMA supports a wide variety and large population (when sufficient water is available) of waterfowl species. Green-winged teal, cinnamon teal, pintail, mallard, gadwall, shoveler and American widgeon are the principal species utilizing this area (Table J-9). Cinnamon teal, redheads, gadwall, ruddy ducks, mallards and Canada geese are the principal breeding species at the Fernley WMA.

Although waterfowl populations utilizing the Fernley WMA fluctuate from year to year, it appears there has been a decline in breeding pairs (Table J-9) and total waterfowl populations (Table J-10) in the past decade. Insufficient water supplies are probably the primary cause of this decline.

Recreational use of the Fernley WMA primarily includes hunting, fishing, and trapping. Hunting is the most important. Although hunting use of the Fernley WMA is relatively light compared with the Stillwater WMA it has remained relatively stable in the past 12 years.

Since 1952, a wide variety of warm and coldwater fish species have been stocked at the Fernley WMA, although in 1977 only northern pike and Sacramento perch existed in any number (DOI, 1977). Fishing use of the Fernley WMA is very light and ranged from about 200-400 angler days per year between 1970 and 1976 and dropped to only about 60 angler days per year in 1978 (Sumner, pers. comm.).

Muskrat are also trapped at the Fernley WMA (Mollini, pers. comm.). Other recreational activities include wildlife observation, environmental education and photography. As with the Stillwater WMA, water availability is the primary factor affecting the Fernley WMA's recreational value.

Lahontan Reservoir

The upper portion of Lahontan Reservoir is an especially important habitat for fish and wildlife. The Carson River channel is surrounded by a forest of cottonwood and willow trees for a distance of several square miles. This area becomes "similar to a southern swamp" (DOI, 1977) when the lake level rises during the spring months. Among the residents are mule deer, beaver, raccoon, porcupine, cottontail, jackrabbit, muskrat, coyote, bobcat, and other mammals. This area is also used by nesting birds, the mourning dove being one of the most important. One of the largest gull rookeries in Nevada extends over several islands in the reservoir. Canada geese also breed on these islands. Pelicans, ducks, and the golden and bald eagles are also common in the area. Resident game birds include chukar partridge, pheasant and quail (DOI, 1977).

Table J-9. Waterfowl Breeding Pair Survey
Fernley Wildlife Management Area

Species	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Canada goose	7	NC	5	3	3	2	4	8	5	1
Mallard	14	14	6	11	2	6	5	2	5	5
Gadwall	8	14	16	14	34	10	14	28	12	20
Pintail	4	1	3	7	-	-	1	1	1	-
Cinnamon teal	53	89	137	79	115	58	58	153	84	63
Shoveler	NC	1	4	1	1	1	-	-	-	-
Redhead	86	43	59	81	22	32	43	78	14	30
Canvasback	-	-	-	-	1	-	-	-	-	1
Ruddy	8	22	20	37	15	15	7	11	33	11
Other ducks	-	-	-	3	3	3	3	7	-	-
Total ducks	173	184	232	233	193	125	131	280	149	130

NC - no count

DATA SOURCE: Nevada Department of Wildlife. Unpublished records. Available from the Nevada Department of Wildlife, Reno, Nevada.

Table J-10. Waterfowl Population Data for Fernley Wildlife Management Area (1968-1979)

	Ducks*	Canada geese	Whistling swans	Coots	Total
1968-69	42,022	1,302	63	2,833	46,220
1969-70	52,582	477	381	5,370	58,812
1970-71	42,410	370	113	3,560	46,453
1971-72	28,737	344	82	3,927	33,090
1972-73	25,305	242	6	4,000	29,553
1973-74	19,839	268	96	3,860	24,063
1974-75	29,944	211	0	1,960	32,115
1975-76	20,567	339	104	5,375	26,385
1976-77	43,586	817	230	5,380	50,013
1977-78	10,411	428	80	745	11,664
1978-79	9,532	420	15	820	10,787

*Includes mallard, gadwall, pintail, green-winged teal, cinnamon teal, American widgeon, shoveler, redhead, ring-neck, canvasback, scaup, bufflehead, ruddy.

SOURCE: Nevada Department of Wildlife records.

Lahontan Reservoir, administered by the Nevada State Park System, is also an important recreational resource in Nevada, with total attendance reaching 515,848 visitor days in 1979 (Meierdierck, pers. comm.). Primary recreational activities are swimming, picnicking, boating and water skiing, sightseeing, fishing and camping.

Lahontan Reservoir receives heavy fishing use, supporting an estimated 123,000 angler days in both 1974 and 1975. The fishery consists of rainbow trout, white crappie, catfish, yellow perch and white bass. The peak fishing season occurs between April and July, although fishing is year-round. Nutrient loadings to the reservoir from the Truckee and Carson Rivers have caused algal blooms and intensified the competition between rough and game fish. Measures to help alleviate these problems were outlined in the Lahontan Reservoir General Recreation Development Plan, developed by the Nevada State Park System in 1974. Other measures were proposed to expand and improve the recreational use of Lahontan Reservoir in this plan.

Lahontan Valley

Historically, the Stillwater, Carson Lake and Carson Sink marshes provided habitat for a large diversity and population of wildlife species. In fact, as little as 7 years ago, Carson Lake was the largest white-faced ibis rookery in the United States. However, following development in the Carson and Truckee River basin and the associated increased water consumption, habitat conditions have steadily deteriorated and numerous areas which held water in the past are now periodically dry, especially during summer months (DOI, 1977). Important waterfowl and wildlife areas include Canvasback Gun Club, Carson Lake Pasture, Massie and Mahala Sloughs, Harmon Reservoir, S-line Reservoir, Soda Lake, Old River Reservoir and the Carson River.

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Personal Communications

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Sumner, Robert. February 1980. Nevada Dept. of Wildlife. Memorandum to Andrea Darling, Jones & Stokes Associates.

__________. February 1980.

Reno-Sparks Joint Water Pollution Control Plant Master Project

Draft Environmental Impact Statement

Appendix K

Selected Permits and Correspondence

January 1975 - NPDES Permit
April 1975 - NPDES Permit
March 1978 - NPDES Permit and Schedule
Early Start Project Special Grant Conditions
Early Start Project Biological Opinion
Early Start Project EIA

June 1980

Prepared For:

U. S. Environmental Protection Agency
Region IX

By:

Jones & Stokes Associates, Inc.
2321 P Street
Sacramento, CA 95816

Permit No. NV0020150
Application No.

AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Federal Water Pollution Control Act, as amended, (33 U.S.C. 1251 et. seq; the "Act"),

The City of Sparks
Public Works Department
431 Prater Way
Sparks NV 89431

is authorized to discharge from Discharge Serial No. 001, the Reno-Sparks Joint Water Pollution Control Plant, located at 8500 Kimlick Lane near Sparks, Nevada

to receiving waters named Steamboat Creek (Latitude 39°31'8.7"N; Longitude 119°42'10.0"W)

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I, II, and III hereof.

This permit shall become effective on FEB 10 1975

This permit and the authorization to discharge shall expire at midnight, May 1, 1977

Signed this day of JAN 10 1975

For the Regional Administrator

Director, Enforcement Division

This page replaces page 3 of the previously forwarded draft permit.

PART I

Page 3 of 19
Permit No. NV0020150

B. SCHEDULE OF COMPLIANCE

1. The permittee shall achieve compliance with the effluent limitations specified for discharges in accordance with the following schedule:

   a. January 1, 1976 complete a facilities plan; and by

   b. January 1, 1977 complete engineering plans and specifications for facilities necessary to assure compliance with the effluent limitations specified in conditions I.B.4 and I.A.2.

   c. Reports of progress with respect to achievement of the above scheduled events shall be submitted to the Regional Administrator no later than July 1, 1975 and July 1, 1976.

2. No later than 14 calendar days following a date identified in the above schedule of compliance, the permittee shall submit either a report of progress or, in the case of specific actions being required by identified dates, a written notice of compliance or noncompliance. In the latter case, the notice shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

3. A "schedule of compliance" means a program composed of two integral parts: (a) plan - description of new or modified facilities to treat and dispose of the effluent; and (b) schedule - a timetable setting forth the date by which all wastewaters will be in compliance with the effluent limitations of this permit. The schedule shall include (if appropriate) dates by which the permittee will accomplish:

   a. Completion of a preliminary engineering plan report;

   b. Completion of construction plans and specifications;

   c. Initiation of construction;

   d. Completion of construction;

   e. Demonstration of compliance with effluent limitations.

A.1. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (based upon a design treatment capacity of 0.88m^3/sec, or 20 mgd)

a. During the period beginning the effective date of this permit and lasting through May 1, 1977 the permittee is authorized to discharge from outfall(s) serial number(s) 001 to Steamboat Creek.

b. Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS kg/day(lbs/day) Average 30-Day	7-Day	Daily Max	Other Units(Specify) Average 30-Day	7-Day	Daily Max	MONITORING REQUIREMENTS Measurement Frequency	Sample Type
low--m^3/Day (MGD)	---	---		---	---	---	Continuous	--
BOD (5-day)*	760 (1700)	1200 (2500)	2330 ~~1200 (2500)~~	10mg/l	15mg/l	---	Daily	Composite
Suspended Solids*	1500 (3400)	2300 (5000)	4600 (10,000)	20mg/l	30mg/l	---	Daily	Composite
Settleable Solids	--	--	--	0.1ml/l	--	0.2ml/l	Daily	Discrete
Total Residual chlorine	--	--	--	--	--	---	Daily	Discrete
Fecal Coliform Bacteria	--	--	--	200/100ml	400/100ml	2000/100ml	Daily	Discrete
Dissolved Oxygen	Shall be greater than or equal to 6.0 mg/l at all times						Daily	Discrete
pH	Shall not be less than 6.5 nor greater than 8.5 at any time						Daily	Discrete
Total Dissolved Solids**	--	--	--	--	--	--	Monthly	Composite
Total Phosphates	—	—	--	—	—	—	Weekly	Composite

*Both the influent and effluent shall be sampled.

There shall be no discharge of toxic substances that cause violation of the provisions of Water Quality Standards for the State of Nevada.

** The total dissolved solids data shall be reported for both the water supply and the effluent.

c. The discharge shall not cause objectionable odors at the surface of the receiving waters.

d. There shall be no discharge of floating solids or visible foam in other than trace amounts.

e. Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):
Influent samples shall be taken downstream from any additions to the trunk sewer and prior to treatment.
Effluent samples shall be taken downstream from any additions from the treatment works and prior to mixing with the receiving waters.

---

4. (based upon a design treatment capacity of 1.8 m^3/sec, or 40 mgd)

Such discharges shall be limited by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS kg/day (lbs/day) Average 30-Day	7-Day	Daily Max	Other Units (Specify) Average 30-Day	7-Day	Daily Max
Flow--m^3/Day (MGD)	---	---	---	---	---	---
Biochemical Oxygen Demand (5-day, 20°C)	1500 (3300)	2300 (5000)	4500 (10,000)	10 mg/l	15 mg/l	---
Suspended Solids	3000 (6700)	4500 (10,000)	9100 (20,000,	20 mg/l	30 mg/l	---
Total Phosphate	450 (1000)	680 (1500)	1400 (3000)	1.0 mg/l as P 3.0mg/l	4.5mg/l	---
Fecal Coliform Bacteria	---	---	---	200/100ml	400/100ml	2000/100ml
Settleable Solids	---	---	---	0.1 ml/l	---	0.2 ml/l
Dissolved Oxygen	Shall be greater than 6.0 mg/l at all times					
pH	Shall not be less than 6.5 nor greater than 8.5 at any time					

The discharge shall not cause objectionable odors at the surface of the receiving waters.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Permit No. NV0020150

AUTHORIZATION TO DISCHARGE

In compliance with the provisions of the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251, et. seq.; the "Act"), and the Nevada Revised Statutes,

Reno-Sparks Joint WPC Plant
431 Prater Way
Sparks, Nevada 89431

is authorized to discharge from a facility located at

8500 Kimlick Lane
Sparks, Nevada 89431

to receiving waters named

Steamboat Creek

Latitude: 39° 31' 8" N
Longitude: 119° 42' 10" W

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I, II, and III hereof.

This permit shall be come effective on May 1, 1977.

This permit and the authorization to discharge shall expire at midnight, April 30, 1982.

Signed this 30TH day of APRIL, 1977.

Donald F. Vanica

Donald F. Vanica
Permits Officer

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning the effective date of this permit and lasting through June 30, 1977, the permittee is authorized to discharge from outfall(s) serial number(s) 001 to Steamboat Creek.

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristics	Discharge Limitations						Monitoring Requirements	
	kg/day (lbs/day)			Other Units (Specify)			Measurement Frequency	Sample Type
	Avg. 30-day	Avg. 7-day	Daily Max.	Avg. 30-day	Avg. 7-day	Daily Max.		
Flow	---	---	---	0.88 m^3/s (20 mgd)	---	---	Continuous	Continuous
BOD (5-day, 20°C)*	757 (1668)	1136 (2502)	---	10 mg/l	15 mg/l	---	Once/day	Composite
Suspended Solids*	1514 (3336)	2271 (5004)	---	20 mg/l	30 mg/l	---	Once/day	Composite
Settleable Solids	---	---	---	0.1 ml/l	---	0.2 ml/l	Once/day	Discrete
Total Dissolved Solids**	---	---	---	---	---	---	Once/month	Composite
Fecal Coliform Bacteria	---	---	---	200/ 100 ml	400/ 100 ml	2000/ 100 ml	Once/day	Discrete
Chlorine Residual***	---	---	---	---	---	---	Once/week	Discrete
Phosphates (PO_4)	---	---	---	---	---	---	Once/week	Composite
Nitrates (NO_3)***	---	---	---	---	---	---	Once/week	Composite
Ammonia Nitrogen (NH_3-N)***	---	---	---	---	---	---	Once/week	Composite
Unionized Ammonia	---	---	---	---	---	---	Once/week	Calculated
Temperature***	---	---	---	---	---	---	Once/week	Discrete
Dissolved Oxygen	Not less than 6.0 mg/l at all times.						Once/day	Discrete
pH***	Not less than 6.5 Standard Units nor greater than 8.5 Standard Units.						Once/day	Discrete

* Both the influent and effluent shall be monitored.
** Both the water supply and effluent shall be monitored.

a. The discharge shall not cause objectionable odors at the receiving waters.

b. There shall be no discharge of floating solids or visible foam in other than trace amounts.

c. There shall be no discharge of toxic substances that cause violation of the water quality standards for the State of Nevada.

d. Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Influent samples shall be taken downstream from any additions to the trunk sewer and prior to treatment. Effluent samples shall be taken downstream from any treatment and prior to mixing with the receiving waters. Parameters designated *** shall also be monitored at the following locations: (1) Steamboat Creek above discharge; (2) confluence of Steamboat Creek and Truckee River; (3) Truckee River above confluence with Steamboat Creek; and (4) Truckee River approximately 200 yards below confluence with Steamboat Creek. All samples shall be taken on the same day from the river bank nearest the treatment plant.

e. Beginning the effective date of this permit, the arithmetic mean of the Biochemical Oxygen Demand (5-day) and Suspended Solids values for effluent samples collected in a period of 30 consecutive calendar days shall not exceed 15 percent of the arithmetic mean of the values for influent samples collected at approximately the same times during the same period. If fewer than four measurements are made during the 30 consecutive calendar day period, then compliance or noncompliance with this condition shall not be determined.

2. During the period beginning July 1, 1977, and lasting through April 30, 1982, the permittee is authorized to discharge from outfall serial number 001 to Steamboat Creek.

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristics	Discharge Limitations						Monitoring Requirement	
	kg/day(lbs/day)			Other Units (Specify)			Measurement Frequency	Sample Type
	Avg. 30-day	Avg. 7-day	Daily Max.	Avg. 30-day	Avg. 7-day	Daily Max.		
Flow	---	---	---	1.06 m³/s (24 mgd)	---	---	Continuous	Continuo
BOD (5-day, 20°C)*	---	---	984(2168)	---	---	10 mg/l	Once/day	Composit
Suspended Solids*	---	---	984(2168)	---	---	10 mg/l	Once/day	Composit
Settleable Solids	---	---	---	0.1 ml/l	---	0.2 ml/l	Once/day	Discrete
Total Dissolved Solids**	13,640 (30,024)	---	17,250 (37,950)	150 mg/l	---	175 mg/l	Once/day	Composit
Fecal Coliform Bacteria	---	---	---	200/ 100 ml	400/ 100 ml	2000/ 100 ml	Once/day	Discrete
Chlorine Residual***	---	---	0.98(2.2)	---	---	0.01 mg/l	Once/week	Discrete
Phosphates (PO_4)	45(100)	---	60(130)	0.5 mg/l	---	0.6 mg/l	Once/week	Composit
Nitrates (NO_3)***	---	---	492(1085)	---	---	5 mg/l	Once/week	Composit
Ammonia Nitrogen (NH_3-N)***	---	---	---	---	---	---	Once/week	Composit
Unionized Ammonia	---	---	---	---	---	---	Once/week	Calculat
Temperature***	Allowable temperature increase above natural receiving water temperature shall not exceed 3°C(5.4°F).							
June-September				17°C(63°F)	---	22°C(72°F)	Once/week	Discrete
October-May				---	---	14°C(57°F)	Once/week	Discrete
Dissolved Oxygen	Not less than 6.5 mg/l for the months of June through September, nor less than 6 mg/l for any single sample.						Once/day	Discrete
pH***	Not less than 6.5 Standard Units nor greater than 8.5 Standard Units.						Once/week	Discrete
Toxicity (note f. below)	---	---	---	---	---	---	Once/month	Discret

* Both the influent and effluent shall be monitored.
** Both the water supply and effluent shall be monitored.

a. The discharge shall not cause objectionable odors at the receiving waters.

b. There shall be no discharge of floating solids or visible foam in other than trace amounts.

c. There shall be no discharge of toxic substances that cause violation of the water quality standards for the State of Nevada.

d. Samples taken in compliance with the monitoring requireemtns specified above shall be taken at the following location(s): Influent samples shall be taken downstream from an additions to the trunk sewer and prior to treatment. Effluent samples shall be taken downstream from any treatment and prior to mixing with the receiving waters. Parameters designated *** shall also be monitored at the following locations: (1) Steamboat Creek above discharge; (2) confluence of Steamboat Creek and Truckee River; (3) Truckee River above confluence with Steamboat Creek; and (4) Truckee River approximately 200 yards below confluence with Steamboat Creek. All samples shall be taken on the same day from the river bank nearest the treatment plant.

e. Beginning the effective date of this permit, the arithmetic mean of the Biochemical Oxygen Demand (5-day) and Suspended Solids values for effluent samples collected a period of 30 consecutive calendar days shall not exceed 15 percent of the arithmetic mean of the values for influent samples collected at approximately the same times during the same period. If fewer thant four measurements are made during the 30 consecutive calendar day period, then compliance or noncompliance with this condition shall not be determined.

f. The survival of Fingerling Rainbow Trout in 96 hour bioassays of the effluent as discharged, shall be no less than that in control tests utilizing water obtained from the Truckee River 50 yards upstream from the confluence of Steamboat Creek.

IN THE MATTER OF)
RENO-SPARKS JOINT WATER POLLUTION CONTROL PLANT)

ORDER

The following order is issued this date pursuant to the powers and duties vested in the Director by Nevada Revised Statutes (NRS) Chapter 445.214, subsections 1, 2, 3, 7, and 12, and in accordance with NRS 445.307, NRS 445.317, subsection 1(a), and NRS 445.324.

On the basis of the Finding of Violation attached hereto and made a part of this Order, the Administrator of the Division of Environmental Protection, pursuant to authority delegated to him by the Director, Department of Conservation and Natural Resources, has determined that Reno-Sparks Joint Water Pollution Control Plant is in violation of Condition I.B.1.c as outlined in the Finding of Violation dated September 23, 1977.

IT IS HEREBY ORDERED:

That Reno-Sparks Joint Water Pollution Control Plant complete the following acts by the dates specified:

1. Adhere to the following schedule for construction of the "early start" and plant upgrading of the Reno-Sparks WPCP, and submit to the Administrator, Division of Environmental Protection, with a copy to the Regional Administrator, EPA Region IX, a report of compliance or non-compliance with each date, within 15 days of the identified date:

	Increment	Date
"Early Start" Compliance Schedule:		
a.	Complete Design	February 1, 1978
b.	Begin Construction	July 1, 1978
c.	Progress Report	January 1, 1979
d.	Progress Report	July 1, 1979
e.	Progress Report	January 1, 1980
f.	End Construction and demonstrate final compliance with limitations on phosphates.	March 1, 1980

Treatment Process Upgrading Compliance Schedule:

a.	Complete final facility plan	July 1, 1979
b.	Begin Final Design	June 1, 1980
c.	Progress Report	Dec. 31, 1980
d.	Complete facility design	June 1, 1981
e.	Award Construction Contract	Oct. 1, 1981
f.	Begin Construction	Dec. 1, 1981
g.	Progress Report	July 1, 1982
h.	Progress Report	Dec. 31, 1982
i.	Complete Construction and demonstrate compliance with permit limitations	July 1, 1983

2. Toxicity - Quarterly bioassays shall be conducted by the permittee on the treatment plant effluent in accordance with the procedures established in the June 14, 1977 letter from the Division of Environmental Protection. This report shall be submitted with the required quarterly discharge monitoring reports.

3. Adhere to the following interim effluent limitations and monitoring requirements.

(See Attachement 1)

DATED: 3/23/78

E. G. Gregory
E. G. Gregory, Administrator
Division of Environmental Protection

A. INTERM EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning the date of this Order (9-23-77) and lasting through May 1, 1982 the permittee is authorized to discharge from outfall serial number 001 [Domestic wastewater] to Steamboat Creek.

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristics	Discharge Limitations kg/day(lbs/day) Avg. 30-day	7-day	Daily Max.	Other Units (Specify) Avg. 30-day	7-day	Daily Max.	Monitoring Requirements Measurement Frequency	Sample Type
Flow	---	---	---	$1.06 m^3/s$ (24mgd)	---	---	Continuous	Continuous
BOD (5-day, 20°C)*	908(2002.8)	1362.6(3004.2)	---	10 mg/l	15 mg/l	---	Once/day	Composite
Suspended Solids*	1816(4005.6)	2653.2(6008.4)	---	20 mg/l	30 mg/l	---	Once/day	Composite
Settleable Solids	---	---	---	0.1 ml/l	---	0.2 ml/l	Once/day	Discrete
Total Dissolved Solids**	---	---	---	---	---	---	Once/month	Composite
Fecal Coliform Bacteria	---	---	---	200/100ml	400/100ml	2000/100ml	Once/day	Discrete
Chlorine Residual***	---	---	---	---	---	0.01mg/l	Once/week	Discrete
Phosphates (PO_4)	---	---	---	---	---	---	Once/week	Composite
Nitrates (NO_3)***	---	---	---	---	---	---	Once/week	Composite
Ammonia Nitrogen (NH_3-N)***	---	---	---	---	---	---	Once/week	Composite
Unionized Ammonia	---	---	---	---	---	---	Once/week	Calculated
Temperature***	---	---	---	---	---	---	Once/week	Discrete
Dissolved Oxygen	Not less than 6.0 mg/l at all times						Once/day	Discrete
pH***	Not less than 6.5 Standard Units nor greater than 8.5 Standard Units.						Once/day	Discrete

*Both the influent and effluent shall be monitored

**Both the water supply and effluent shall be monitored

a. The discharge shall not cause objectionable odors at the receiving water.

b. There shall be no discharge of floating solids or visible foam in other than trace amounts.

c. There shall be no discharge to toxic substances that cause violation of the water quality standards for the State of Nevada.

d. Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Influent samples shall be taken downstream from any additions to the trunk sewer and prior to treatment. Effluent sample shall be taken downstream from any treatment and prior to mixing with the receiving waters. Parameters designed *** shall be monitored monthly with a discrete sample at the following locations until July 1, 1978. At that time these parameters shall be monitored once every two weeks with a discrete sample at these locations for the duration of the order. (1) Steamboat Creek above discharge; (2) Confluence of Steamboat Creek and Truckee River; (3) Truckee River 30 yds. above confluence with Steamboat Creek; and (4) Truckee River approxiamtely 200 yards below confluence with Steamboat Creek. All samples shall be taken on the same day from the river bank nearest the treatment plant.

EPA Special Grant Conditions for the Early Start Project

7. The Grantee shall adopt a resolution which incorporates the following elements:

    a) The Grantee recognizes that the air pollutant emissions associated with the vehicles used by the permanent and transient population accomodated by this project will interfere with the attainment and maintenance of the National Ambient Air Quality Standards in the absence of adequate programs to control such emissions.

    b) The Grantee shall, to the extent permissible by law, commit appropriate and necessary resources toward the implementation of the EPA-approved Nonattainment Plan (State Implementation Plan revision) and shall coordinate its general planning process with the Nonattainment Plan.

    c) Before the first interim Step 3 grant payment, the Grantee shall submit a schedule for early implementation of control strategies for mitigating the projected increase in emissions of each air pollutant for which the primary National Ambient Air Quality Standards are violated, which increase may reasonably be anticipated to result directly or indirectly from the new sewage treatment capacity which would be created by such construction. These control strategies must be incorporated into the Nevada State Implementation Plan.

    d) Before subsequent interim payments for construction of the Early Start Project, the Grantee must demonstrate to EPA that implementation of the selected control measures is proceeding as scheduled.

The Grantee shall obtain from Washoe County and any incorporated municipalities which participate or will participate in the Joint Water Pollution Control Plant system, resolutions committing these entities to obligations comparable to those incurred by the Grantee. The Grantee shall obtain such resolutions within 90 days from the date of acceptance of this grant offer.

8. The Grantee shall, to the maximum extent of its legal authority, develop, promote, implement, and enforce a vigorous water conservation plan and program to reduce per-capita municipal water supply withdrawals from the Truckee River in the Reno area. The plan and program shall include:

    a) Documentation of past water conservation efforts and successes achieved, and

    b) An action program to continue to reduce residential and commercial water use on a per-capita basis. The action program shall realize an objective by no later than the operational date of the "Early Start Project" of per capita water use equivalent to that during the 1977 drought conditions. The action program should be developed and implemented in association with Sierra Pacific Power Company, and written evidence of Sierra Pacific Power Company's commitments shall be obtained by the Grantee.

The Grantee shall hold at least one public hearing on the water conservation plan and program prior to submittal to EPA.

The Grantee shall submit the water conservation plan and program to EPA within 6 months from the date of acceptance of this grant offer, and shall submit quarterly reports of progress thereafter.

9. The Grantee shall develop and implement a program to reduce the sewage influent mass loads consistent with the capability of the JWPCP as designed and operated to process such loads. The program shall include:

    a) a sewer system survey to identify individual sources with major contributing loads,

    b) provisions for obtaining voluntary written commitments of identified sources to reduce such loads by employing solids handling, packaging, and disposal methods rather than grinding-liquid flushing methods,

    c) continued cooperation with the Washoe County Health District to provide for safe and environmentally sound disposal practices for solid wastes.

The Grantee shall submit quarterly reports of progress commencing January 1, 1979 and ending at such time as "Master Project" becomes operational.

Policy Act of 1969 and the Endangered Species Act of 1973 and the Biological Opinion, dated August 23, 1978, issued by the Fish and Wildlife Service, U.S. Department of the Interior, for the Early Start Project, the following grant conditions are made a part of this grant award:

a. The Grantee shall negotiate with the City of Sparks, Nevada, to execute an intermunicipal agreement in which:

(1) The City of Sparks (NPDES permittee) shall agree to comply with the applicable requirements of this grant award, and

(2) The Grantee shall adopt an action program committing the necessary legal, financial, and technical resources to assist the City of Sparks (NPDES permittee) in maintaining compliance with all NPDES permit requirements, compliance schedules, and orders issued by the Nevada Division of Environmental Protection or by EPA.

The intermunicipal agreement including the action program shall be submitted to EPA and the Nevada Division of Environmental Protection within 60 days after the acceptance of this grant offer.

b. The Grantee agrees that water quality problems created by increased urbanization and return flows from agricultural water diversions in the Reno-Sparks area shall be alleviated by implementing best management practices and other water pollution control measures which are consistent with the Washoe Council of Governments Water Quality Management Plan (Section 208 Plan), as approved by EPA. The Grantee shall adopt a resolution committing to such implementation and submit it to EPA within 60 days after the acceptance of this grant offer.

c. The Grantee shall develop and implement a water quality monitoring program that will detect water quality and quantity changes to determine if current water quality conditions are degraded as a result of the discharge from the Early Start Project. The Grantee shall consult with EPA, USGS, the U.S. Fish and Wildlife Service, Nevada Fish and Game, and the Nevada Division of Environmental Protection in the design of the monitoring network and analytical program. "Current water quality conditions" shall be defined and specified by EPA and the Nevada Division of Environmental Protection in consultation with USFWS, at such time as EPA approves the monitoring program design. The monitoring program design shall be submitted to EPA for approval no later than 120 days from acceptance of this grant offer. The monitoring program shall be effectively operational, including an on-line notification system, within 6 months from EPA's approval of the monitoring program design, and shall be continuously operated until the "Master Project is complete and operational.

d. The Grantee shall develop a contingency plan to: 1) insure that the discharge from the Early Start Project will not jeopardize the continued existence of the listed Endangered and Threatened species, 2) insure that current water quality conditions in the Truckee River are not degraded, and 3) eliminate any detrimental effect on the listed species detected by the monitoring program.

The contingency plan shall identify all feasible measures to eliminate any detrimental effects on the listed species and to insure that current water quality conditions are not degraded. Such measures shall include an identification of all feasible wastewater treatment operational techniques and all feasible sources of an interim water supply to augment river flows. This identification shall be submitted to EPA within 6 months of acceptance of the grant offer.

As part of the contingency plan, the Grantee shall negotiate with any appropriate parties, including the Secretary of the Interior, to execute an agreement to secure, either directly or using the authorities and services of any third party, access to or reservation of any sources of water that may be used for an interim period to augment river flows as may be necessary to eliminate any detrimental effects on the listed species and to insure that current water quality conditions in the Truckee River are not degraded. Access or reservation may be secured through agreement, contract, purchase, exchange, storage credits (banking), or any other feasible method. Such agreement shall be secured and submitted to EPA within 12 months of acceptance of the grant offer.

e. If the monitoring program detects an adverse change in current water quality conditions as a result of the discharge from the Early Start Project, the Grantee shall immediately implement any necessary measures, including any augmenting river flows as may be necessary, to eliminate any detrimental effects on the listed species and to insure that current water quality conditions in the Truckee River are not degraded. The Grantee shall notify EPA and the USFWS of any actions taken under this grant condition.

In the event that these measures are not sufficient as determined by the Regional Administrator to eliminate detrimental effects on the listed species and to insure that current water quality conditions are not degraded, EPA shall:

1) reinitiate a formal Section 7 consultation with the U.S. Fish and Wildlife Service pursuant to the Endangered Species Act, and

2) impose a flow limitation on wastewater discharges from the Early Start Project pending the outcome of the Section 7 consultation and the implementation of the recommendations that result from that consultation, or until such time as the "Master Project" is in operation.

f. The Grantee shall negotiate with the City of Sparks, Washoe County, Washoe Health District, and Nevada Division of Environmental Protection to execute an agreement to impose requirements on approval of any so-called "package plants" such that approvals will not result in degradation of water quality or reduction in water quantity in the Truckee River, and will not otherwise result in adverse environmental impacts. The agreement shall provide for the phase-out of any "package plants" at such time as "Master Project" becomes operational. The Grantee shall submit the agreement to EPA within 90 days from the date of acceptance of this grant offer.

g. The Grantee shall develop the "Master Project" in a manner that allows for the long term conservation of the listed species and their designated habitats by:

(1) Conducting studies in consultation with appropriate Federal and State agencies to determine the maximum and safe chronic exposure levels of un-ionized ammonia, nitrite and nitrate singly and in combination on the cui-ui. The studies should specifically determine any effect of the above pollutants on reproduction, behavior, and normal egg development and hatching. Data must also be obtained on the impacts of increased treated wastewater discharge on the food chains of the cui-ui and the Lahontan cutthroat trout.

(2) Developing the "Master Project" so as to result in water quality which will provide for the reestablishment of the listed species in the Truckee River.

11. The Grantee agrees that failure to comply with these grant conditions as determined by the Regional Administrator shall result in the withholding, conditioning, or restricting by EPA of this grant award and any future grant to the Grantee and that such withholding, conditioning, or restricting of grants shall be in addition to any administrative remedy as provided in 40 CFR Part 30 or any legal remedy available to EPA. The withholding, conditioning, or restricting of any grant to the Grantee shall remain in effect until such time as the Regional Administrator determines that the Grantee is not in non-compliance.

In addition, by virtue of changed circumstances due to violation of grant conditions, EPA may re-initiate a Section 7 consultation process with the U.S. Fish and Wildlife Service under the Endangered Species Act.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

DATE: MAY 3 1 1978

SUBJECT: Environmental Impact Appraisal
Reno-Sparks Joint Water Pollution Control Plant
Early Start Program, Step III C 32 0114

FROM: Richard S. Williamson
Environmental Engineer, Nevada Branch
Water Division, Region IX

TO: Files

As indicated in Section 6.212(a) of the April 14, 1975 Final Regulations (40 CFR Part 6) for the Preparation of Environmental Impact Statements published by the Environmental Protection Agency in the Federal Register, "When an environmental review indicates there will be no significant impact or (when) significant adverse impacts have been eliminated by making changes in the project, the responsible official must prepare a Negative Declaration to allow public review of this decision before it becomes final... The responsible official shall have an Environmental Impact Appraisal supporting the Negative Declaration available for public review when the Negative Declaration is released..."

Pursuant to Section 6.504(a)(5) of the EIS regulations, I recommend EPA approval of a Step 3 (construction) grant for an Early Start Program to construct an additional 10 million gallons per day of treatment plant capacity and provide phosphorous removal and dechlorination facilities for the entire plant flow. This recommendation is based upon the urgency to achieve compliance with the NPDES discharge interim limitations and to correct existing water quality problems related to the sewage discharged to the Truckee River. Projected wastewater flows are expected to exceed the design capacity of the present facilities in the near future due to the fast paced economic growth being experienced in the service area.

After critically evaluating all information submitted for environmental review, I am making the recommendation that an Environmental Impact Statement should be not be written for the construction of the Early Start Program under the aforementined authority. The following is an Environmental Impact Appraisal supporting the Negative Declaration and my recommendation.

Project Background

The Reno-Sparks Regional Service Area (known as Truckee Meadows) includes the cities of Reno and Sparks, and adjacent unincorporated areas of Washoe County including: Verdi, Sun Valley, and Panther Valley (see attachment 1). The Regional Service area lies in the Truckee River Basin east of the Sierra Nevada Range and west of the Virginia Range. This semiarid area covers approximately 114 square miles and has an average elevation of approximately 4,400 feet above sea level. Land use trends indicate increasing urbanization of the agricultural and ranching lands in and adjacent to the Service Area. Tourism, gaming, and warehousing are the primary economic base for the Service Area. Although the construction trades currently account for a large percentage of employment, this job market is relatively short term.

The current design capacity for the Reno-Sparks Joint Water Pollution Control Plant (JWPCP), which was completed in 1967, is 20 mgd. Wastewater flows have reached 22 mgd during the height of the tourist seasons (prior to the drought of 1976-77 which stimulated wastewater flow reductions) The existing facility is an activated sludge system which provides secondary treatment, sludge digestion, and sludge disposal by stockpiling in drying beds. The NPDES permit, Compliance Schedule, and present growth characteristics dictate the need for the plant to be expanded and upgraded to include phosphorous and residual chlorine removal.

Current flows at the plant are averaging approximately 19 mgd. The NPDES permit allows the discharge of 24 mgd, as long as said discharge complies with the interim effluent limitation contained in the permit. Current flow records indicate that the City of Reno contributes 14.3 mgd of the total flow, and the City of Sparks contributes 4.2 mgd. Both Cities own 10 mgd of the plant capacity. The City of Reno leases excess capacity from the City of Sparks in order to treat its flows in excess of 10 mgd (excess is currently 4.8 mgd).

A Draft Facility Plan was completed by the City of Reno in August, 1975. Upon reviewing this document, the Basin Plan prepared by the Washoe Council of Governments, and other relevant documents, EPA announced its decision to prepare a Federal Environmental Impact Statement (EIS) on December 3, 1975. The Draft EIS was issued for public review and comment on January 20, 1977 and a Public Hearing was held on April 12, 1977. At this time it became known that the State of Nevada would be issuing in May, 1977 a new National Pollutant Discharge Elimination System (NPDES) permit with new requirements for continued discharge to the Truckee River system. The Facilities Plan and Draft EIS had been prepared under the criteria contained in the original EPA-issued NPDES permit which meant that the required treatment levels to meet the new State-issued permit requirements were different from those needed to meet the discharge requirements in effect while the plans were being prepared. This factor severely affected the cost-effectiveness analysis contained in the original planning documents.

Due to the need for further planning as evidenced above, and the fact that the JWPCP was being overloaded and causing further degradation of the Truckee River water quality, it was decided to segment the project in the following manner in order to expedite progress towards compliance with NPDES requirements.

Early Start Program: This segment entails the design of those project components common to all alternatives analyzed in the Master Project. This consists of a 10 mgd capacity increase and the addition of phosphorous removal and dechlorination facilities for the entire 30 mgd capacity.

Master Project: The overall issues of required treatment levels to meet the new NPDES permit limitations, ultimate capacity needs, effluent disposal, sludge disposal, and interceptor extensions/replacement are to be examined and evaluated through a revised Facility Plan and EIS.

On March 8, 1977 EPA released a Negative Declaration for the design of the Early Start Program. The major support for the release of this Negative Declaration was the fact that the project would not be constructed until it was demonstrated that environmental impacts resulting from the Early Start Program would be mitigated through the EIS process. It was originally estimated that the Final EIS would be completed in February, 1978. However, on August 22, 1977 EPA released a Public Notice announcing the withdrawal of the Draft EIS from public review, and stated that an amended EIS would be prepared, along with a revised Facility Plan in order to address the requirements of the new NPDES permit, and subject additional alternatives to a rigorous cost-effectiveness evaluation.

At the present time the Final EIS for the Master Project is scheduled for release in early 1980. The net result of these necessary schedule changes is that the Early Start Program impacts must be mitigated separately from the Master Project EIS if the project is to proceed on schedule. The mitigation efforts for the Early Start Program will be described in a later section.

Proposed Project

The proposed alternative for the Early Start Program is the 10 mgd expansion alternative with phosphorous removal and dechlorination facilities. The Early Start Project consists of those elements of the Master Project that are common to all alternatives. The common components eligible for construction under this program are:

1. One comminuter
2. One raw sewage pump
3. One grit tank
4. Two primary sedimentation tanks
5. One aeration tank
6. Two secondary sedimentation tanks
7. Three phosphorous stripping tanks
8. One, post aeration tank
9. One chlorine contact chamber
10. One digestion tank
11. Two waste activated sludge thickening tanks
12. Two chemical flocculation tanks
13. One sludge gas holding tank
14. One dechlorination facility
15. Influent flow meters

The effluent from the plant shall continue to be discharged to Steamboat Creek at a location approximately 200 yards upstream from its confluence with the Truckee River (The ultimate discharge point will be determined in the Master Project). The solids will be stored in holding/evaporation ponds, as is the current practice (Ultimate sludge disposal will be determined in the Master Project).

At the current time the 10 mgd capacity shall result in the following allocations of capacity ownership at the Reno-Sparks JWPCP:

City of Reno	18.5 MGD
City of Sparks	11.5 MGD*

(* 1.5 of Sparks capacity is to be leased to Sun Valley Water and Sanitation District.)

The capacity supplied by the Early Start Program 10 mgd increase will eliminate the need for Reno to lease treatment capacity from Sparks. The JWPCP NPDES permit shall be amended to require that any future capacity leasing arrangements be approved by the appropriate regulatory agencies. It is estimated that Sparks may not need any additional capacity. The ultimate capacity for Reno will be ascertained in the Master Project Facility Plan. The capacity provided to Reno through the Early Start Project will relieve the existing capacity shortage until such time that the Master Project is implemented.

The proposed project is in conformance with the Basin Plan in that it is a step towards the improvement of water quality in the Truckee River. Coordination with the Areawide Water Quality Management Plan (Section 208) has assured that this project conforms to the goals of the Washoe Council of Governments Areawide Plan to protect the beneficial uses of the Truckee River. Ultimate compliance with the 208 Plan must result from the Master Project. The capacity provided for in the Early Start Program is consistent with the population projections and land use plan developed thus far in the WCOG 208 planning process.

The alternatives for the Early Start Program were few, as by regulation the project was limited to consisting of the common elements of the alternatives considered in the Master Project. Capacity increases of 10, 13.5 and 20 mgd had been analyzed in the original Facility Plan. It was determined that the Early Start Program would consist of the lowest capacity increase being considered (10 mgd). This increase allows for the treatment of wastewater from areas which are currently experiencing septic tank failure, and provides capacity relief until such time that the plant's ultimate capacity can be evaluated through the Master Project.

Primary Impacts

Primary impacts associated with construction of the Early Start Program would be limited to the existing facility site. Plant expansion would make little impact on the visual character of the existing facility. There will be minimal impacts on the archaeology, soils, geology, wildlife, habitat, and seismic characteristics of the existing site since it contains no known sensitive resources. Air quality, acoustics, solid waste, energy supplies, economics, and employment would be impacted by the construction and operation

of the proposed facilities. Construction of these elements will result in a temporary disturbance of soil which will increase to a minor degree the suspended particulates in the air for short periods during construction. Noise levels during construction will be somewhat higher than normal operating levels at the plant. Because of the remote location of the plant, these impacts will be minimal. Solid wastes generated by construction activities will be greater during construction than during normal plant operation. Local landfill sites are adequate to accept this waste. Employment needs will almost double during construction. Twenty-three employees operate the existing facility. An additional 25 to 30 people will be employed during construction of the facility expansion. Operation of the Early Start Project facilities will result in reduced quantities of phosphorous and chlorine being discharged in the effluent, thereby reducing the potential for algal blooms and toxic conditions in the lower Truckee River. The addition of aeration capabilities through the capacity increase will assure consistent compliance with the interim effluent limitations. The effect on the water quality of the Truckee River resulting from the additional treatment capabilities cited above are considered a significant beneficial impact of the project.

Secondary Impacts:

The major secondary impacts resulting from the implementation of the Early Start Program are the exacerbation of the air pollution problems in the service area, and the continued conversion of agricultural and open space lands to urban uses.

It is estimated that the 10 MGD capacity increase will accommodate an additional 74,000 people. The effects of this increase in population (permanent residents and visitors) will primarily impact the air quality of the region, which currently is not meeting the National Ambient Air Quality Standards. The Reno-Sparks area has been designated by the Governor as a "non-attainment area", and therefore a plan is required to bring the air quality into conformance with national standards as mandated by the Clean Air Act. This plan is called a Non-attainment Plan (NAP) and must be completed by WCOG and submitted by the State of Nevada to EPA by January 1, 1979.

As discussed earlier it was originally anticipated that the environmental impacts of the Early Start Program would be mitigated through the Master Project EIS. However, due to the schedule changes for the Master Project, it is now necessary that the mitigation measures be implemented separately from the Master Project if the Early Start Program is to proceed on schedule.

On December 7, 1977, a meeting was held with the Cities of Reno and Sparks, the Nevada Division of Environmental Protection, and representatives from the Air Division and Water Division of EPA. The purpose of this meeting was to plan a program to mitigate the identified air quality impacts in conformance with Federal requirements. The following program was developed and found acceptable to the participating agencies:

(1) An Early Start Mitigation Program would be prepared in close coordination with the NAP.

(2) A grant condition would be attached to the Step III Construction Grant, that calls for the submittal of an acceptable mitigation plan and implementation schedule prior to the first interim Step III payment. All payments related to Construction Grants at the Reno-Sparks JWPCP will be suspended until such time that the plan is found to conform with federal requirements. The Grant Condition shall read as follows:

Proposed Step 3 Grant Special Conditions
Reno-Sparks Joint Water Pollution Control Plant
Early Start Project

1. The City of Reno shall adopt a resolution which incorporates the following elements:

   a) The City recognizes that the air pollutant emissions associated with the vehicles used by the permanent and transient populations accommodated by this project will interfere with the attainment and maintenance of the National Ambient Air Quality Standards in the absence of adequate programs to control such emissions.

   b) The City shall, to the extent permissible by the law, commit appropriate and necessary resources towards the implementation of the EPA-approved Nonattainment Plan (State Implementation Plan revision) and shall coordinate its general planning process with the Non-attainment Plan.

   c) Before the first interim Step III payment, the City shall submit a schedule for early implementation of control strategies for mitigating the projected increase in emissions of each air pollutant for which the primary National Ambient Air Quality Standards are violated, which increase may reasonably be anticipated to result directly or indirectly from the new sewage treatment capacity which would be created by such construction. These control strategies must be incorporated into the Nevada State Implementation Plan.

   d) Before subsequent interim payments for construction of the early start program, the City must demonstrate to EPA that implementation of the selected control measures is proceeding as scheduled.

2. The Grantee shall obtain from Washoe County and any incorporated municipalities which participate or will participate in the Joint Water Pollution Control Plant system, resolutions committing these entities to obligations identical to those in Special Condition No. (1).

3. The grantee shall obtain the resolutions pursuant to Special Conditions Nos. (1) and (2) within ninety (90) days from the date of this grant offer.

During the funding of the project, if any portion of the Non-attainment Plan is determined to be inadequate or inadequately implemented, the City of Reno will be determined to be in non-compliance with the grant conditions and grant funds will be withheld.

The City of Reno City Council adopted the above resolution on March 27, 1978. It will also be contained in the Step III grant in order to assure its enforcement.

The conversion of agricultural and open space lands to urban uses is a trend which is anticipated in the latest land use plan developed for the area. The population accommodated by the Early Start Program, and the subsequent development necessary to house the new residents, is expected to be consistent with the current land use strategy.

Other secondary impacts relate to continued development of the Truckee River floodplain, the need for additional municipal services (e.g. water supply, electricity, gas, medical facilities, schools, etc.), potential development of areas with site of potential archaeological significance, and the economic impacts of bond repayment and generation of operation and maintenance funds. These impacts will be fully evaluated and mitigated in the Master Project EIS.

Short-term uses versus long-term productivity relate primarily to water quality in the Truckee River. Construction of the Early Start Program components will result in improved water quality due to the phosphorous removal facilities, and the additional capacity provided to relieve overloaded plant conditions during the height of the tourist season. Maintenance of the long-term productivity of the Truckee Meadows environment is dependent upon the adoption of adequate mitigation measures to minimize the secondary impacts relative to the project.

Construction and operation of the proposed project requires the irreversible, irretrievable commitment of energy, materials, and land. Well-planned design, construction and operational practices will avoid unnecessary use of these resources. Construction operations will comply with all State and local requirements to prevent particulate matter from becoming airborne, and all cleared areas will be stabilized during and following construction.

Agencies consulted in the preparation of the Facility Plan and Environmental Impact Assessment for the Early Start Program include the Department of Interior, Nevada Division of Environmental Protection, Washoe Council of Governments, and the Pyramid Lake Paiute Indian Tribal Council.

A Public Hearing was held January 3, 1977 at a special meeting of the Reno City Council. Concern was expressed regarding the potential effects which may result by way of the 10 MGD capacity increase. Other comments addressed a proposed effluent disposal site in Spanish Springs Valley, and the ultimate costs of the Pho-Strip process being considered as a method for phosphorous removal. These comments were satisfactorily addressed in the final environmental impact assessment for the Early Start Program.

In conclusion, on the basis of the above-stated reasons, EPA has made the determination that the proposed Early Start Program will not have a significant adverse impact on the environment, and, therefore, the preparation of an Environmental Impact Statement for this phase of the water quality improvements for the Truckee River is not warranted.

Project Evaluator

John Wise
Branch Chief

United States Department of the Interior
FISH AND WILDLIFE SERVICE
WASHINGTON, D.C. 20240

ADDRESS ONLY THE DIRECTOR,
FISH AND WILDLIFE SERVICE

In Reply Refer To:
FWS/OES 375.0

AUG 23 1978

Mr. Douglas M. Costle
Administrator, Environmental
Protection Agency
401 M'Street SW
Washington, D.C. 20406

Dear Mr. Costle:

This responds further to the Environmental Protection Agency's (EPA) June 7, 1978, request for consultation, pursuant to Section 7 of the Endangered Species Act of 1973, on EPA's actions relating to water quality management in the Lower Truckee River, Nevada, and their effects on the Endangered cui-ui (Chasmistes cujus) and the Threatened Lahontan cutthroat trout (Salmo clarki henshawi) and their habitats.

The consultation was requested by the Regional Administrator in San Francisco from the Service's Regional Director in Portland, Oregon, and was initiated at the regional level. The letters requesting the consultation and the Service's response are enclosed for your information. By my letter of August 7, 1978, EPA was requested to provide additional information on other projects which should be considered in association with this action to determine cumulative effects on the two listed fish species because of a recent opinion from the Solicitor of the Department of the Interior. The August 7 letter also appointed a consultation team to assist me in completing the consultation process (see enclosures).

Members of the consultation team met with your representatives, representatives of other Federal agencies, and local sources of expertise on August 17, 18, and 19 in Reno, Nevada, to discuss the proposed action, projects that should be considered for cumulative effects and anticipated effects on the two listed fish species and their habitats. Mr. Gail Kobetich and Mr. Don King were not present at those meetings but were involved in reviewing and discussing the proposed action and the information obtained during the meetings. A list of the participants is enclosed.

The consultation team reviewed information provided by EPA on the proposed action, information provided by other Federal agencies, academic, county government, and private sources, or available within the Service. Copies of pertinent reports and documents are included in an administrative record maintained in the Office of Endangered Species, Washington, D.C., a are incorporated herein by reference.

EPA specifically requested "interim consultation" on the "Early Start Project", an interim measure to expand and upgrade the Reno-Sparks Joint Water Pollution Control Plant (JWPCP) and "formal consultation" on the Environmental Impact Statement and associated project documents for the "Master Project", which will bring the Reno-Sparks JWPCP into full compliance with the final effluent limitations contained in its National Pollutant Discharge Elimination System Permit.

During initial discussions on the scope of the consultation it was noted that the regulations implementing Section 7 do not provide for "interim consultation" and that sufficient information was not available to allow consultation on the "Master Project". It was agreed by EPA and the consultation team that formal Section 7 consultation would be appropriate for the Early Start Project. It was agreed that informal consultation during the development of the various studies and the EIS on the Master Project should continue and formal consultation would be requested prior to publication of the Draft EIS. Therefore, this biological opinion addresses only the Early Start Project for the Reno-Sparks JWPCP.

The Reno-Sparks JWPCP, a conventional activated sludge secondary treatment plant with a current design capacity of 20 million gallons per day, is the primary sewage treatment facility for the two cities. The National Pollutant Discharge Elimination System (NPDES) permit, its compliance schedule, and present growth characteristics dictate the need for the JWPCP to be expanded and upgraded. The plant is currently operating at capacity and it is anticipated that additional capacity will be required within the year.

The "Master Project" is being developed and will be implemented with funds granted by EPA, to provide the most cost-effective project alternative to meet the NPDES final limitations and to provide the ultimate solution to protect water quality in the Truckee River. "Master Project" alternatives are being analyzed in conjunction with preparation of an EIS. The NPDES compliance schedule requires the elimination of pollutants discharged by the JWPCP through the "Master Project" by July 1, 1983.

In order to expedite the improvement of water quality conditions in the Truckee River, the "Early Start Project" has been segmented from the "Master Project". The Early Start Project consists of only those elements which are common to all viable alternatives being examined in the Master Project. Implementation of the Early Start Project will assure early compliance with the NPDES permit interim limitations and provide early compliance with the phosphorous removal requirements contained in the NPDES permit final limitations.

The proposed Early Start Project will increase the capacity of the JWPCP by 10 million gallons per day and will provide partial phosphorous removal. The plant will discharge approximately 20 mg/l total ammonia nitrogen, 1.0 mg/l un-ionized ammonia nitrogen and 1.77 mg/l nitrate and nitrite nitrogen. Ortho-phosphate concentrations would be approximately 0.5 mg/l. The portions of the plant to be expanded include primary and secondary sedimentation tanks, an aeration tank, a post aeration tank, and chlorination and sludge treatment facilities. The portions of the plant to be upgraded include the construction of phosphorus removal and dechlorination facilities.

Upgrading treatment by including phosphorus removal will result in lowering the concentration of phosphorus discharged into the river. However, an increase of plant capacity by 10 million gallons per day will have an adverse impact on water quality by increasing the daily mass loading of nitrogen into the river. (The Master Project is being designed so as to eliminate the discharge of nitrogen compounds.) Effluent from the plant will continue to be discharged in Steamboat Creek at a location approximately 200 yards upstream from its confluence with the Truckee River.

In order to determine whether the Early Start Project is likely to jeopardize the continued existence of the listed species, it is necessary to consider the current status of these species and the cumulative effects from the Early Start Project and other proposed projects, programs or actions in the area under study. The consultation team reviewed the information on the proposed project provided by EPA, and in conjunction with EPA attempted to identify other projects, programs or actions not otherwise considered, the effects of which when combined with the proposed project may jeopardize the continued existence of the listed species. The team considered the possible actions of, and where appropriate contacted and/or met with, agencies and other entities that might undertake actions affecting the species or water quality and quantity of the Truckee River, including the U.S. Army Corps of Engineers, Bureau of Land Management, Bureau of Reclamation, Bureau of Indian Affairs, Nevada Department of Fish and Game and the Washoe Council of Governments. Two anticipated actions were identified as possibly producing significant effects.

The Reno-Sparks area is experiencing rapid growth which is expected to continue in the foreseeable future. The urbanization associated with the expected growth is likely to result in an increase in urban surface water runoff in addition to the increased sewage previously discussed. Currently, the sewage and storm water drain systems are interconnected, but an active program to separate the two systems is in progress. Urban surface water runoff will then be discharged directly into the Truckee River without the benefit of any wastewater treatment. The Washoe council of Governments (WCOG) monitored the drains during the summer of 1977 and noticed several

potential water quality problems, due primarily to heavy metal constituents in the runoff. Thus, the potential for water quality degradation exists as urbanization increases and the drain separation program is completed.

The WCOG is moving to check the water quality degradation potential from increased surface water runoff through implementation of the Areawide Water Quality Management Plan developed with grant funds from EPA under Section 208 of the Federal Water Pollution Control Act. The purpose of the plan is to provide for preservation of beneficial uses of the Truckee River through elimination of the discharge of pollutants. The Plan is specifically designed to eliminate the introduction of pollutants into the river through discharge of surface water runoff from urban and other areas. The Plan is in final approval stages and local governmental entities have proposed ordinances to provide the regulatory mechanisms to implement the plan. Thus it can reasonably be expected that associated increases in surface water runoff from increased urbanization will not appreciably degrade water quality in the Truckee River.

Actions also are being taken for the benefit of the listed fish species in the Truckee River. The Fish and Wildlife Service has an active ongoing program designed to restore the Endangered cui-ui through implementation of the approved Cui-ui Recovery Plan. The Service also has a program in effect which is designed to restore the Threatened Lahontan cutthroat trout in the Truckee River and Pyramid Lake.

The major restoration efforts thus far have included artificial propagation of the Lahontan cutthroat trout and the stocking of Pyramid Lake, development of Lahontan cutthroat brood stocks and management of the Summit Lake population to increase spawning runs and develop a reliable egg source for the hatchery programs. The Pyramid Lake Fishway was constructed to create fish passage to the Truckee River and is operated and maintained for the purpose of reestablishing spawning runs of cui-ui and Lahontan cutthroat trout.

Hatchery facilities have been developed to annually produce cui-ui fry and fingerlings to improve recruitment of the species and studies have been designed to assess cui-ui population levels and develop methods and management schemes to restore the species.

The Pyramid Lake Paiute Tribe has likewise been actively involved in the management and restoration of these species. The Tribe operates a cutthroat trout hatchery including a net pen cultural facility in the lake and is planning an additional trout hatchery which will be in operation by 1980. A cui-ui hatchery also has been operated by the Tribe for the past two years under a cooperative agreement with the Service. A creel census program and enforcement of sport fishing regulations are other tribal programs which support the restoration of the two listed species.

A summary of the biological data considered during this consultation is provided below:

The cui-ui was listed originally as an Endangered species in the Federal Register on March 11, 1967. Critical Habitat has not yet been determined but is currently under consideration by the Service. The cui-ui is a lacustrine sucker endemic only to Pyramid Lake, Nevada, but uses the Truckee River during the spawning season. The population was once very abundant and important to the culture and diet of the Paiute Indians. The cui-ui population has decreased greatly since the turn of the century and currently comprises less than 1 percent of the fish in Pyramid Lake.

The cui-ui spend most of the year in the littoral zone of the lake; however, the most critical stage of its life history occurs during the spring spawning season in the Truckee River. While little is known about the physiological characteristics which determine its habitat requirements, it is known that cui-ui historically spawned in the lower Truckee River between Derby Dam and Pyramid Lake. Based on available data, population increases of certain year classes of cui-ui can be correlated to high river flows for the same year.

The primary reason for the drastic decrease of the cui-ui was the destruction of spawning habitat caused by the construction of Derby Dam in 1905 and the trans-basin diversion of most of the Truckee River. Over the years the lake level has receded and a large silt delta has formed at the mouth of the Truckee, precluding spawning runs in all but very high river runoff years. If attempts to allow cui-ui access to their former spawning habitat become successful, water quality and quantity in the lower Truckee River will become the critical factors in restoration of the cui-ui. To ensure species survival during the interim Early Start Project, there must be a program of monitoring water quality at Pyramid Lake and the lower Truckee River and an available water supply to dilute pollutant concentrations, if necessary.

The Lahontan cutthroat trout was listed as Endangered on October 13, 1970. Subsequently it was reclassified to Threatened on July 16, 1975. Critical Habitat has not yet been determined. The Lahontan cutthroat trout is the largest of all cutthroat and has always been considered a valuable game fish. The known primary distribution includes Pyramid, Summit, Independence and Walker Lakes and streams in the Lahontan Basin and the west slope of the Sierra Nevada Mountains. The largest population of the Lahontan is in Pyramid Lake. The population originally was so abundant that it supported a large commercial fishery. Although the current population size is not absolutely known, there has been a marked increase since 1940, when the species disappeared from Pyramid Lake. This recent increase is due to an active artificial propagation program.

The Lahontan cutthroat live both in lakes and in streams and generally require water of the same quality and quantity as that required by other trout species. Spawning habitat is similar to that required by other stream spawning trout species. Historically, the cutthroat spawned throughout the entire Truckee River system.

Lahontan cutthroat trout populations in the streams largely have been depleted through competition and hybridization with other trout species while the reasons for the decline of the Pyramid Lake population are the same as for the cui-ui: construction of Derby Dam and out-of-basin divserion of water from prime spawning-rearing habitat. Early attempts were made to provide fish passage facilities at Derby Dam, primarily for trout, but these efforts were a failure. By the late 1920's, the last spawning runs disappeared and the last known adult was said to have passed from the lake by about 1940. Recent efforts have been made to provide the Lahontan cutthroat access to the spawning areas in the Truckee River a numerous studies have been conducted delineating the feasibility of reestablishing natural spawning runs. Water quality and quantity are the critical factors that must be addressed before successful reintroduction of this species into the Truckee River is possible.

Current research by Pacific Environmental Laboratory has shown that the existing nitrite, nitrate, and un-ionized ammonia concentrations in the Truckee River below the Reno-Sparks area are in excess of those considere safe for aquatic communities. According to project data, there will be an increase in these constituents as a result of the Early Start Project. During late summer, fall, and early winter low flow periods, the concentration of un-ionized ammonia, nitrite and nitrate in the river will exceed LC50's and chronic long term toxicity levels for cutthroat trout and salmonids in general. However, fish do not naturally occur in the river at this time. Since the Early Start Project is an interim program and the Master Project will eventually remove pollutants, the Early Start Project will not reduce the likelihood of long term recovery of the species in the river.

Increased concentrations of chemicals in the river could produce adverse effects in the lake since the food chain in Pyramid Lake is relatively short and apparently very efficient and fish productivity is good. Any change in the lake's nutrient cycles could adversely affect the food chain and the production of the cui-ui and the Lahontan cutthroat trout.

No information is available to the Service which indicates that current water conditions in the Truckee River are posing a serious threat to the survival of existing fish populations. In addition, the Service and the Bureau of Indian Affairs, Paiute Indian Tribe, are engaged in a stocking and restoration program that should provide for the survival and limited recovery of the listed species during the life of the interim Early Star

Project. However, the long term survival and recovery of the species depends upon the effective elimination of the discharge of pollutants into the Truckee River through the Master Project.

If the proposed project is operated so as not to further degrade water quality and quantity in the Truckee River and since the Master Project is likely to result in an overall improvement in water quality and quantity of the Truckee, the proposed project will not appreciably reduce the potential for survival and recovery of the listed species.

Conclusion

Based on my consultation team's review of the above information and the best information available to the Service at this time, it is my biological opinion that EPA's action on the Early Start Project for the Reno-Sparks JWPCP is not likely to jeopardize the continued existence of the Endangered cui-ui or Threatened Lahontan cutthroat trout and will contribute, during the interim period, to the conservation of these species and their habitats if EPA implements or requires implementation of the following recommendations:

1. Development and implementation of a monitoring program that will detect water quality and quantity changes to insure that current water conditions are not degraded. The Service will provide assistance in the development of this program, if desired.

2. Development of an interim water supply to augment river flows to eliminate any detrimental effects detected through the monitoring program.

3. Development and implementation of a vigorous water conservation plan to reduce water supply withdrawals from the Truckee River in the Reno-Sparks area.

4. Adoption and implementation of the Washoe Council of Governments "208" Water Quality Management Plan to alleviate water quality problems created by increased urbanization in the Reno-Sparks area.

5. Prevention of actions which will result in further degradation of water quality or reduction of water quantity in the Truckee River. Particular attention should be given to package sewer plants.

6. Develop the "Master Project" in a manner that allows for the long term conservation of the listed species and their habitats in accordance with the following:

   a. Conduct studies to determine the maximum and safe chronic exposure levels of un-ionized ammonia, nitrite and nitrate singly and in combination on the cui-ui. The studies should specifically determine any effect of the above pollutants on reproduction, behavior, and normal egg development and hatching. Data must also be obtained on the impacts of increased sewage discharge on the food chains of the cui-ui and the Lahontan cutthroat trout.

   b. Continue informal consultation during the development of the "Master Project" leading to a formal consultation prior to publication of the draft Environmental Impact Statement.

   c. Develop the "Master Project" so as to result in water quality and quantity which will provide for the re-establishment of the listed species in the Truckee River.

I am sincerely appreciative of EPA's efforts and positive actions on this most important consultation and your assistance to my consultation team which expedited the development of this biological opinion. Please let me know if we can be of further assistance to you or answer any questions concerning this opinion. We are convinced that continued cooperation and consultation on this most important project will contribute greatly to the improvement of water quality and quantity in the Truckee River and ultimately to the recovery of the listed species and restoration of their habitats.

Sincerely yours,

Keith M. Schreiner

Acting Director

Enclosures

cc: Reno Fisheries Assistance Office